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THE RADIATION ENVIRONMENT IN THE EXPERIMENTAL FACILITIES OF THE DIAMOND ORDNANCE RADIATION FACILITY

by

Philip G. Berman

1 December 1965

U.S. ARMY MATERIEL COMMAND
HARRY DIAMOND LABORATORIES
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ABSTRACT

Neutron fluence, fluence per kilowatt-hour, gamma ray exposure and gamma ray exposure rate were measured at the Harry Diamond Laboratories' Diamond Ordnance Radiation Facility. The data are presented in graphical form to facilitate their use.

The maximum attainable radiation exposure measured in the pulse mode is as follows:

Irradiation Area	Neutron Fluence (E > 10 kev) (n/cm^2)	Gamma Ray Exposure (R)
Exposure room	6.8×10^{13}	5×10^{5}
Pool	5.2×10^{13}	3×10^{5}

The maximum attainable radiation exposure rate, measured at a reactor power level of 250 kw, is as follows:

Irradiation Area	Neutron Flux (E > 10 kev) ($n/cm^2 sec$)	Gamma Ray Exposure Rate (R/sec)
Exposure room	5.4×10^{12}	2.1×10^{3}
Pool	8.0×10^{11}	1.3×10^{3}

1. INTRODUCTION

The Harry Diamond Laboratories' Diamond Ordnance Radiation Facility (DORF) has as its source of radiation a TRIGA Mark F reactor. Since an accurate knowledge of the quantity and quality of the radiation fields is essential to an accurate determination of radiation effects, an extensive fast-neutron mapping program and some gamma ray measurements were made in the facility's irradiation areas. The majority of the data was gathered by the Nuclear Defense Laboratory. This, together with data taken by the author and others, are herein collected, normalized, and graphed to show gradients, anomalies, if any, and overall neutron spectra in the different irradiation areas during reactor pulse power operation ($2.65 reactivity insertion, 1200-Mw peak pulse power). Some data for steady-state operation are also presented.

2. DIAMOND ORDNANCE RADIATION FACILITY

The Diamond Ordnance Radiation Facility is located within the limits of the Forest Glen Annex of the Walter Reed Army Medical Center, about one mile north of the city limits of Washington, D. C., in Montgomery County, Maryland.

The TRIGA Mark F reactor core is a cylindrical array of uranium-zirconium hydride fuel elements suspended in a water-filled pool from a movable carriage. Experiments may be carried out in either one of two areas, the pool or the exposure room. These experimental areas are shielded from one another by rotating lead shield doors. Thus, experiments may be conducted in one while they are being set up or dismantled in the other.

The reactor may be operated in any one of three modes. These are (1) steady state to a maximum power level of 100 kw, (2) square wave to a maximum steady-state power level of 250 kw, or (3) pulsed to a maximum peak power of 1200 Mw.

The reactor core is suspended in its pool of water from a mobile carriage. The capability of moving from one side of the pool to the other is thus provided. The reactor may be operated at any point in its travel. The lower portion of one end of the pool projects into a large room called the exposure room, where irradiations may be conducted without the necessity of a waterproof housing.

The reactor pool is approximately clover-leaf shaped (fig. 1), being divided into two halves by lead-filled doors. The pool is approximately 13 ft wide and 12 ft long and is nominally 19 ft deep (fig. 2). The distance from the water surface to the top of the parapet is about 3 ft. The parapet is 6 ft above the test instrumentation area floor level.

The exposure room is 20 ft square and 8 ft high (fig. 3 and 4). An access plug door provides an opening to the room with minimum dimensions of 5 ft 8 in. by 5 ft 8 in. A portion of the reactor tank, called the thimble, projects into the room. When the reactor core is adjacent to the exposure room, in the thimble, a minimum thickness of approximately 1 in. of water is between the reactor core shroud and the thimble wall.

A dimple, 4 in. wide and 10 in. high, is indented 3 5/8 in. into the thimble at the core centerline to provide, effectively, an in-core irradiation position for small objects (fig. 5 and 6). A movable 2-in. thick lead shield surrounding the thimble is provided. The shield allows the neutron-gamma ratio to be varied. It has an access hole to the dimple. A lead plug to fill the access hole is available.

3. DOSE MEASUREMENT METHOD

3.1 Dosimeter Locations

The many positions at which data were desired are located using a grid system. Thus, the dosimeter positions may be indicated by a three-digit symbol such as 3C5, denoting a height, angle, and radial distance, respectively. For the pool, the heights are given in figure 7; and the angles and radial distances from the core shroud are shown in figure 8. For the exposure room, the heights are given in figure 9; and the angles and radial distances from the thimble are given in figure 10.

3.2 Neutron Dosimetry

The neutron spectrum was measured using the threshold detector system (ref 1, 2, 3). The threshold detector system of neutron measurement consists of irradiating selected isotopes in a properly shielded configuration. The resultant neutron-induced activity is measured and is directly related to the intensity of the neutron field in which the detector was placed. The minimum neutron energy which the detector is sensitive to is termed its threshold. Hence, upon irradiating a set of selected threshold detectors, one may determine the number of neutrons which the detector was exposed to above the threshold energy. A differencing technique provides the number of neutrons in each energy interval.

The following energy thresholds are those most recently used by the Nuclear Defense Laboratory.

TABLE I. ISOTOPE THRESHOLDS AND REACTION

Isotope	Threshold	Reaction
Au-197-Au-197 covered	< 0.4 ev	Au-197 (n,γ) Au-198
U-235	1.5 kev	fission
Pu-239	10.0 kev	fission
Np-237	600 kev	fission
U-238	1.5 Mev	fission
S-32	3.0 Mev	S-32 (n,p) P-32
Mg-24	6.3 Mev	Mg-24 (n,p) Na-24
Al-27	8.1 Mev	Al-27 (n,α) Na-24

All detectors are shielded from thermal neutrons by 1.92 cm of boron, 93 percent enriched in B-10 (ref 4) except the Au-197-Au-197 Cd system.

3.3 Gamma Ray Dosimetry

The gamma ray measurements reported herein were taken with several different types of detectors. The pulse measurements were obtained using Bausch and Lomb cobalt glass plate sandwiches (ref 5). The steady-state 30-kw measurements were made by Edgerton, Germeshausen, and Grier using three types of thermoluminescent dosimeters (TLD), composed of calcium fluoride, natural lithium fluoride, and lithium-7 fluoride, respectively. They also used carbon-carbon dioxide and tissue-equivalent ionization chambers (ref 6).

The Bausch and Lomb glass plates have active centers formed in them by interaction with both gamma and neutron radiation. Shielding and calibration allow some compensation for neutron-induced effects. The glass is evaluated by measuring the change in transmission of light of 400 or 500 mμ wavelength. A calibration curve then yields the gamma ray exposure.

The thermoluminescent dosimeters are affected in a manner similar to the cobalt glass. However, readout is effected by heating the dosimeter material and measuring the light output or luminescence. The luminescence is proportional to gamma ray exposure and/or neutron fluence.

Ion chambers measure directly the current produced by the passage of ionizing radiation through the sensitive volume. Both neutrons and gamma rays produce effects, but the magnitudes can be greatly altered by selecting the proper materials of construction for the chambers.

4. RESULTS

4.1 Pulsed Radiation

The pulsed neutron and gamma-ray measurements were made with a reactivity insertion of $2.65, which yielded a pulse peak power of 1200 Mw. Measurements were made in the core, in the pool, and at various positions in the exposure room including the dimple. The data are presented in Tables II, III, IV, and V. The positions referred to in Tables III, IV, and V are shown in figures 8 and 10. The data in Tables II and IV,

for the pool and exposure room, are reproducible to within ±10 percent; their accuracy is estimated to be within ±25 percent.

The fast-neutron data (fluence and spectrum) for the pool are plotted in figures 11 through 49. The fast-neutron data (fluence and spectrum) for the exposure room are plotted in figures 50 through 110. The gamma ray measurements are plotted in figures 111 through 113.

Most of the pulse data was obtained using aluminum-clad fuel elements. Recent data using stainless-steel-clad fuel show that, in the pool, neutron flux decreases more rapidly with distance than when using aluminum-clad fuel. Plotting the ratio of the 3.0-Mev neutron dose per pulse from the aluminum-clad core to that from a stainless-steel-clad core versus distance from the assembly yields a line with a slope of 7 percent per inch of water. Data for both cores were taken with the core in the infinite water condition. The variation can be ascribed to the widely differing cross sections of the two types of cladding. The stainless steel clad is now standard at the HDL-DORF Facility.

Except for in-core positions, the maximum neutron fluence in the pool (5.2×10^{13} n/cm^2, E > 10 kev) occurs 29 in. above the pool floor (core midplane) adjacent to the core. The maximum fluence in the exposure room (6.8×10^{13} n/cm^2, E > 10 kev) is attainable 48 in. above the exposure room floor in the dimple. The gradient of the fast-neutron field in the exposure room is much smaller than in the pool irradiation area.

Unfortunately, the gamma radiation exposure rates are so great that conventional means of gamma-ray spectrum determination would be saturated and consequently useless. Therefore, only the total exposures are given. The detectors used to obtain these data may have actually recorded the influence of fast and thermal neutrons in addition to the gamma-rays.

Bearing this in mind, the gamma-ray exposure 29 in. above the pool floor is shown in figure 111 and is the best available at present. Bausch and Lomb cobalt glass dosimeters were used to obtain the data.

The radiation level at a particular point in the exposure room is governed by the point-thimble distance and the reactor-core-thimble separation. At the thimble, with minimum water thickness between core and room, the levels are essentially the same as for points adjacent to the reactor core in the pool. However, the gamma radiation intensity falls off nonexponentially since, as one moves back from the thimble,

the geometry varies greatly. As air is the only attenuating material in the exposure room, the radiation intensity does not fall off as sharply in the exposure room as it does in the pool. Data both with and without the 2-in. lead shield in place are shown in figures 112 and 113.

4.2 Steady-State Radiation

The majority of experiments are conducted with the reactor operated in the pulse mode. Therefore, only a limited number of steady-state measurements were made, in the pool and exposure room, at various steady-state power levels < 100 kw, and at 250 kw. Neutron and gamma-ray data taken in the pool are presented in Table VI and are plotted in figure 114. The neutron fluence and fluence rate for position 3G2 in the exposure room (at core midpoint 22 in. from the thimble) are given in Table VII, and are plotted in figures 115 through 118. Gamma-ray data for the exposure room with varying thicknesses of water between the thimble wall and core shroud are presented in figures 119 through 123.

Correlation studies show that pulse data may be used to position experiments for steady-state irradiation by assuming 7 kw-hr of energy for one reactor pulse. Alternatively, the equivalent steady-state data can be approximated by using this factor with pulse data, with fair reliability.

One other comment that can be made concerning a steady-state operation is that, although the delivery rate is much higher in the pulse mode, a greater number of neutrons per hour are delivered in the steady-state mode.

5. SUMMARY

The Diamond Ordnance Radiation Facility provides a short (10-msec PWHM) pulse of high intensity fast-neutron and gamma radiation, which is suitable for radiation effects tests. Convenient irradiation areas are provided.

The exposure room provides a 3,200-cu ft volume where the fast-neutron fluence ($E > 10$ kev) varies less than a factor of 1000 from the front to the back of the room.

The pool irradiation area provides a decrease in neutron fluence of more than 10,000 in 30 in. of water. Thus, a wide range of neutron intensities is available for various types of experiments.

6. ACKNOWLEDGMENT

The author wishes to thank D. T. Kilminster and the staff of the Nuclear Defense Laboratories for their cooperation in performing the measurements reported herein.

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TABLE II. IN-CORE NEUTRON FLUENCE

Position	Thermal Fluence (n/cm^2)	Fast Neutron Fluence (>10 kev) (n/cm^2)
F-30	3.5×10^{14}	5.4×10^{14}
E-24	4.6×10^{14}	8.5×10^{14}
D-18	5.3×10^{14}	1.1×10^{15}
D-11	6.0×10^{14}	1.2×10^{15}
E-14	5.3×10^{14}	8.6×10^{14}
F-17	5.3×10^{14}	6.4×10^{14}

TABLE III. NEUTRON FLUENCE IN THE POOL

POSITION	U235 (10^{13} n/cm^2)	PU (10^{13} n/cm^2)	NP (10^{13} n/cm^2)	U238 (10^{12} n/cm^2)	S (10^{13} n/cm^2)	MG (10^{11} n/cm^2)	AL (10^{10} n/cm^2)
1B1	2.7	1.6	1.5	7.2	2.2	1.4	6.4
1C1	2.9	2.2	1.8	8.6	2.8	1.5	7.3
1D1	2.4	1.4	1.5	7.7	2.6	1.3	6.1
1F1	3.1	1.9	1.5	8.3	2.4	1.4	7.0
1G1	2.4	1.7	1.2	6.8	2.4	1.3	6.3
1H1	2.1	1.4	1.0	5.0	1.8	1.5	5.7
1I1	2.6	1.8	1.4	6.8	2.3	1.3	6.4
1J1	3.0	2.1	1.9	9.5	2.7	1.6	7.7
2B1	7.1	4.4	3.8	21.8	5.9	3.3	16.0
2D1	6.0	3.8	4.0	20.1	5.6	3.1	14.6
2E1	7.4	5.3	4.6	19.2	5.9	3.0	14.4
2F1	8.2	5.4	5.7	21.5	6.6	3.97	18.4
2G1	6.0	4.5	2.8	13.7	5.3	2.8	13.9
2H1	5.5	4.2	4.0	20.4	5.4	3.0	14.4
2J1	5.0	3.0	2.7	11.4	4.1	2.4	11.4
3B1	3.4	2.2	2.1	10.7	2.8	1.6	8.1
3C1	2.8	1.9	1.5	7.7	2.5	1.4	6.7
3D1	2.8	1.9	2.0	9.5	2.8	1.6	7.6
3F1	3.4	1.9	1.8	9.6	2.7	1.6	7.7
3G1	2.4	1.8	1.5	6.9	2.5	1.4	6.9
3H1	2.0	1.4	1.5	6.7	1.7	1.2	5.3
3I1	3.5	2.4	1.6	8.9	3.2	1.6	8.1
3J1	2.1	1.3	1.3	6.9	1.8	1.1	5.4

TABLE III (Continued)

POSITION	U235 (10^{12} n/cm^2)	PU (10^{12} n/cm^2)	NP (10^{12} n/cm^2)	U238 (10^{12} n/cm^2)	S (10^{11} n/cm^2)	MG (10^{10} n/cm^2)	AL (10^{10} n/cm^2)
1B2	4.4	3.9	3.6	2.2	5.0	3.8	1.9
1D2	6.8	4.2	2.9	2.0	5.6	4.1	2.2
1F2	3.7	2.9	2.3	2.2	4.9	4.0	1.9
1H2	4.3	4.0	3.5	1.7	5.2	3.9	2.1
1J2	4.2	2.1	1.9	1.7	3.7	2.9	1.6
2B2	8.7	5.8	5.0	3.2	9.3	6.9	2.5
2D2	9.4	6.7	5.8	3.9	1.2	8.3	1.3
2F2	8.2	5.2	4.9	3.9	9.2	7.0	3.5
2H2	7.2	5.5	4.9	3.0	9.2	6.6	3.4
2J2	5.1	3.4	2.9	2.1	6.4	4.7	2.6
2J2	4.8	3.4	3.5	2.1	6.2	4.9	2.4
3B2	3.3	2.6	2.3	1.4	4.4	3.4	1.8
3D2	5.1	4.7	4.2	2.1	6.1	4.6	2.3
3F2	3.2	2.2	2.0	1.4	4.1	3.3	1.7
3H2	5.1	2.8	3.0	1.7	4.8	3.4	2.0
3J2	2.2	1.6	1.5	1.0	3.0	2.6	4.2

TABLE III (Continued)

POSITION	U235 (10^{11} n/cm²)	PU (10^{11} n/cm²)	NP (10^{11} n/cm²)	U238 (10^{11} n/cm²)	S (10^{10} n/cm²)	MG (10^{9} n/cm²)	AL (10^{9} n/cm²)
1B3	6.0	2.8	1.8	1.8	6.4	7.2	3.4
1D3	3.8	2.6	1.6	1.7	6.2	6.5	3.2
1F3	3.3	2.4	1.4	1.5	5.2	6.1	3.0
1H3	6.7	4.4	2.1	1.3	7.1	7.2	3.5
1J3	3.1	2.1	1.3	2.1	5.1	5.8	2.8
2B3	6.6	6.6	3.0	2.6	10.5	11.1	4.9
2D3	6.5	4.7	4.4	3.0	10.4	10.7	5.0
2F3	5.4	3.2	2.2	3.2	7.9	8.8	4.1
2H3	9.0	6.5	2.8	2.8	9.6	10.6	5.0
3J3	4.1	2.7	2.0	2.8	6.9	7.6	3.7
3B3	3.7	2.9	2.6	1.9	6.5	7.0	3.3
3D3	4.2	2.8	1.9	1.9	6.6	6.9	3.5
3F3	4.0	2.0	2.1	1.3	4.8	5.1	2.6
3H3	3.0	2.2	1.3	1.5	5.2	5.5	2.9
3J3	0.2	2.1	0.9	1.5	3.6	4.0	2.0

POSITION	U235 (10^{10} n/cm²)	PU (10^{10} n/cm²)	NP (10^{10} n/cm²)	U238 (10^{10} n/cm²)	S (10^{10} n/cm²)	MG (10^{9} n/cm²)	AL (10^{9} n/cm²)
1F4	4.8	4.2	5.6	2.6	0.9	1.4	0.6
2D4	12.0	9.4	8.3	5.9	2.3	3.1	1.6
2E4	10.5	7.4	7.8	5.8	2.1	3.1	1.5
2F4	8.2	7.7	12.3	5.3	2.0	3.1	1.6
2G4	9.6	8.5	6.9	5.5	1.8	2.6	1.5
2H4	10.1	7.7	7.4	5.5	2.0	2.6	1.4
3F4	8.6	6.6	6.9	4.7	1.8	2.6	1.2

TABLE III. (Continued)

POSITION	U235 (10^{10} n/cm²)	PU (10^{10} n/cm²)	NP (10^{10} n/cm²)	U238 (10^{10} n/cm²)	S (10^{9} n/cm²)	MG (10^{8} n/cm²)	AL (10^{8} n/cm²)
1D5	1.1	2.7	2.9	2.0	2.8	*	2.8
1E5	0.8	0.6	0.7	0.66	2.0	*	*
1F5	1.5	1.1	0.97	0.94	2.5	*	2.4
1G5	2.1	0.8	1.1	1.3	*	3.7	*
1H5	2.4	0.98	0.92	0.95	2.7	*	3.1
2D5	1.6	1.5	1.2	1.5	3.7	6.6	3.0
2E5	*	1.1	0.96	1.1	2.6	3.9	2.5
2F5	4.8	0.8	*	1.6	3.1	5.7	2.4
2G5	1.0	0.1	0.93	1.5	3.4	5.6	3.5
2H5	2.5	2.7	0.68	1.9	4.1	6.0	3.3
3D5	1.3	0.9	*	1.8	*	*	3.1
3E5	1.5	1.2	1.0	0.87	3.0	*	2.6
3F5	0.82	0.71	0.65	0.63	2.2	*	*
3G5	1.3	1.1	*	0.88	3.1	*	*
3H3	1.1	*	1.1	0.81	2.3	*	2.5

POSITION	U235 (10^{10} n/cm²)	PU (10^{9} n/cm²)	NP (10^{9} n/cm²)	U238	S	MG	AL
1F6	*	*	*	*	*	*	*
2D6	*	*		*	*	*	*
2E6	0.17	1.36	*	*	*	*	*
2F6	1.4	*	*	*	*	*	*
2G6	0.27	2.9	*	*	*	*	*
2H6	2.27	1.0	*	*	*	*	*
3F6	0.18	*	3.9	*	*	*	*

TABLE III (Continued)

POSITION	U235 (10^9 n/cm^2)	PU (10^9 n/cm^2)	NP	U238	S	MG	AL
1E7	*	*	*	*	*	*	*
1F7	*	*	*	*	*	*	*
1G7	*	*	*	*	*	*	*
2D7	1.0	*	*	*	*	*	*
2E7	0.96	*	*	*	*	*	*
2F7	*	7.4	*	*	*	*	*
2H7	*	3.5	*	*	*	*	*
3E7	*	*	*	*	*	*	*
3F7	*	*	*	*	*	*	*
3G7	2.4	*	*	*	*	*	*

* Detector sensitivity insufficient to detect dose or detector background too high to detect dose.

TABLE IV. NEUTRON FLUENCE IN THE EXPOSURE ROOM

Position	U235 (n/cm^2)	PU (n/cm^2)	NP (n/cm^2)	U238 (n/cm^2)	S (n/cm^2)	MG (n/cm^2)	AL (n/cm^2)
2A1	$2.4x10^{11}$	$1.8x10^{11}$	$1.0x10^{10}$	$7.9x10^{10}$	$2.4x10^{10}$	$2.3x10^{10}$	$1.8x10^{9}$
2B1	$3.0x10^{11}$	$1.3x10^{11}$	$8.8x10^{10}$	$8.0x10^{10}$	$3.0x10^{10}$	$2.1x10^{9}$	$1.3x10^{9}$
2D1	$2.0x10^{11}$	$1.7x10^{11}$	*	$1.1x10^{11}$	$2.0x10^{10}$	$1.6x10^{9}$	$1.1x10^{9}$
2G1	$2.6x10^{11}$	$1.9x10^{11}$	$1.5x10^{11}$	$9.4x10^{10}$	$2.7x10^{10}$	$2.7x10^{11}$	$2.1x10^{9}$
2J1	$2.2x10^{11}$	$1.5x10^{11}$	*	$8.6x10^{10}$	$1.9x10^{10}$	$1.2x10^{9}$	$5.0x10^{8}$
2L1	$2.5x10^{11}$	$1.8x10^{11}$	$7.5x10^{10}$	$5.2x10^{10}$	$2.5x10^{10}$	$2.7x10^{9}$	$1.6x10^{9}$
2M1	$2.1x10^{11}$	$1.8x10^{11}$	$1.2x10^{11}$	$8.1x10^{10}$	$2.4x10^{10}$	$2.4x10^{9}$	$1.5x10^{9}$
3A1	$1.6x10^{13}$	$1.3x10^{13}$	$1.0x10^{13}$	$6.0x10^{12}$	$1.9x10^{12}$	$1.3x10^{12}$	$7.4x10^{10}$
3B1	$3.4x10^{13}$	$2.1x10^{13}$	$2.0x10^{13}$	$1.2x10^{13}$	$3.2x10^{12}$	$1.8x10^{11}$	$9.0x10^{10}$
3D1	$2.6x10^{13}$	$2.0x10^{13}$	$2.1x10^{13}$	$1.0x10^{13}$	$2.7x10^{12}$	$1.7x10^{11}$	$8.5x10^{10}$
3G1	$8.7x10^{13}$	$6.8x10^{13}$	$5.3x10^{13}$	$2.8x10^{13}$	$7.9x10^{12}$	$4.0x10^{11}$	$2.1x10^{11}$
3J1	$2.1x10^{13}$	$1.9x10^{13}$	$1.4x10^{13}$	$9.5x10^{12}$	$2.5x10^{12}$	$1.6x10^{11}$	$8.3x10^{10}$
3L1	$2.2x10^{13}$	$1.5x10^{13}$	$1.4x10^{13}$	$5.5x10^{12}$	$2.4x10^{12}$	$1.6x10^{11}$	$7.2x10^{10}$
3M1	$1.2x10^{13}$	$8.8x10^{12}$	$8.4x10^{12}$	$3.8x10^{12}$	$1.3x10^{12}$	$8.6x10^{10}$	$4.7x10^{10}$
4A1	$4.9x10^{11}$	$3.3x10^{11}$	$2.3x10^{11}$	$1.4x10^{11}$	$3.9x10^{10}$	$3.0x10^{9}$	$1.9x10^{9}$
4B1	$3.6x10^{11}$	$2.1x10^{11}$	$1.5x10^{11}$	$1.1x10^{11}$	$3.2x10^{10}$	$3.0x10^{9}$	$1.5x10^{9}$
4D1	$6.3x10^{11}$	$3.4x10^{11}$	$3.0x10^{11}$	$1.9x10^{11}$	$4.5x10^{9}$	$4.7x10^{9}$	$2.4x10^{9}$
4G1	$4.8x10^{11}$	$3.9x10^{11}$	$2.9x11^{11}$	$1.5x10^{11}$	$4.7x10^{10}$	$4.0x10^{9}$	$2.6x10^{9}$
4J1	$4.4x10^{11}$	$2.9x10^{11}$	$2.5x10^{11}$	$1.4x10^{11}$	$3.4x10^{10}$	$3.8x10^{9}$	$2.1x10^{9}$
4L1	$3.1x10^{11}$	$1.9x10^{11}$	$2.1x10^{11}$	$9.7x10^{10}$	$3.2x10^{9}$	$2.5x10^{9}$	$1.4x10^{9}$
4M1	$2.7x10^{11}$	$2.1x10^{11}$	$1.6x10^{11}$	$9.2x10^{10}$	$2.7x10^{10}$	$2.3x10^{9}$	$1.5x10^{9}$
2A2	$9.1x10^{11}$	$6.6x10^{11}$	$5.9x10^{11}$	$5.1x10^{11}$	$9.5x10^{10}$	$4.0x10^{9}$	$3.3x10^{9}$
2B2	$1.2x10^{12}$	$8.5x10^{11}$	$7.3x10^{11}$	$4.6x10^{11}$	$8.9x10^{10}$	$4.8x10^{9}$	$4.2x10^{9}$

*Detector sensitivity insufficient to detect dose or detector background too high to detect dose.

TABLE IV (Continued)

Position	U235 (n/cm²)	PU (n/cm²)	NP (n/cm²)	U238 (n/cm²)	S (n/cm²)	MG (n/cm²)	AL (n/cm²)
2D2	$1.1x10^{12}$	$8.9x10^{11}$	$8.2x10^{11}$	$4.7x10^{11}$	$1.3x10^{11}$	$5.0x10^{9}$	[illegible]$.6x10^{8}$
2G2	$1.9x10^{12}$	$1.3x10^{12}$	$1.1x10^{12}$	$5.2x10^{11}$	$1.6x10^{11}$	$9.8x10^{9}$	$4.9x10^{9}$
2J2	$1.3x10^{12}$	$1.2x10^{12}$	$7.9x10^{11}$	$6.6x10^{11}$	$1.3x10^{11}$	$5.3x10^{9}$	$4.6x10^{9}$
2L2	$1.5x10^{11}$	$4.7x10^{11}$	$6.2x10^{11}$	$5.4x10^{11}$	$1.1x10^{11}$	$4.3x10^{9}$	$3.8x10^{9}$
2M2	$9.2x10^{11}$	$4.7x10^{11}$	$4.0x10^{11}$	$2.7x10^{11}$	$9.0x10^{10}$	$1.1x10^{10}$	$2.9x10^{9}$
3A2	$3.4x10^{12}$	$2.2x10^{12}$	$2.3x10^{12}$	$9.2x10^{11}$	$2.5x10^{11}$	$9.5x10^{9}$	$7.9x10^{9}$
3B2	$7.2x10^{12}$	$2.4x10^{12}$	$2.9x10^{12}$	$1.3x10^{12}$	$3.5x10^{11}$	$1.3x10^{10}$	$1.1x10^{10}$
3C2	$3.3x10^{12}$	$2.6x10^{12}$	$2.4x10^{12}$	$1.4x10^{12}$	$4.6x10^{11}$	$1.7x10^{10}$	$1.5x10^{10}$
3D2	$4.4x10^{12}$	$3.2x10^{12}$	$3.0x10^{12}$	$1.6x10^{12}$	$4.6x10^{11}$	$1.7x10^{10}$	$1.5x10^{10}$
3E2	$8.8x10^{12}$	$3.1x10^{12}$	$4.1x10^{12}$	$2.5x10^{12}$	$5.8x10^{11}$	$6.0x10^{10}$	$1.5x10^{10}$
3G2	$8.2x10^{12}$	$4.3x10^{11}$	$5.5x10^{12}$	$2.2x10^{11}$	$5.7x10^{11}$	$2.0x10^{10}$	$1.6x10^{10}$
3G2	$4.9x10^{12}$	$3.2x10^{12}$	$3.8x10^{12}$	$1.8x10^{12}$	$4.6x10^{11}$	$2.7x10^{9}$	$1.4x10^{10}$
3I2	$7.3x10^{12}$	$4.2x10^{12}$	$3.2x10^{12}$	$1.9x10^{11}$	$6.4x10^{11}$	$6.4x10^{10}$	$1.7x10^{10}$
3J2	$8.6x10^{12}$	$3.9x10^{12}$	$2.8x10^{12}$	$1.8x10^{12}$	$5.9x10^{11}$	$6.1x10^{10}$	$1.7x10^{9}$
3K2	$5.7x10^{12}$	$4.8x10^{12}$	$2.3x10^{12}$	$1.5x10^{12}$	$4.7x10^{11}$	$5.0x10^{10}$	$1.3x10^{10}$
3L2	$3.5x10^{12}$	$2.5x10^{12}$	$2.3x10^{12}$	$1.3x10^{12}$	$3.7x10^{11}$	$1.4x10^{10}$	$1.1x10^{10}$
3M2	$3.0x10^{12}$	$1.8x10^{12}$	$1.3x10^{12}$	$8.7x10^{11}$	$2.8x10^{11}$	$3.3x10^{10}$	$8.5x10^{9}$
4A2	$1.2x10^{12}$	$1.1x10^{12}$	$7.6x10^{11}$	$6.2x10^{11}$	$1.2x10^{11}$	$4.4x10^{9}$	$4.3x10^{9}$
4B2	$1.5x10^{12}$	$1.1x10^{12}$	$1.3x10^{12}$	$5.1x10^{10}$	$1.4x10^{10}$	$6.0x10^{9}$	$5.2x10^{9}$
4G2	$2.0x10^{12}$	$1.5x10^{12}$	$1.2x10^{12}$	$6.0x10^{11}$	$1.9x10^{11}$	$1.1x10^{10}$	$5.5x10^{9}$
4J2	$2.2x10^{12}$	$1.2x10^{12}$	$8.6x10^{11}$	$5.5x10^{11}$	$1.8x10^{10}$	$2.0x10^{10}$	$5.2x10^{9}$
4L2	$1.1x10^{12}$	$8.6x10^{11}$	$1.2x10^{12}$	$4.9x10^{11}$	$1.3x10^{11}$	$5.4x10^{9}$	$4.7x10^{9}$
4M2	$1.2x10^{12}$	$9.4x10^{11}$	$6.8x10^{11}$	$4.9x10^{11}$	$1.1x10^{10}$	$1.4x10^{10}$	$3.8x10^{9}$

TABLE IV (Continued)

POSITION	U235 (10^{12} n/cm^2)	PU (10^{11} n/cm^2)	NP (10^{11} n/cm^2)	U238 (10^{11} n/cm^2)	S (10^{11} n/cm^2)	MG (10^{10} n/cm^2)	AL (10^{9} n/cm^2)
2B3	1.1	5.9	4.1	2.8	0.9	0.9	2.6
2D3	1.4	9.5	8.46	4.6	11.0	1.2	3.5
2E3	1.4	7.3	5.1	3.5	13.1	1.5	4.2
2G3	1.2	5.4	3.97	2.7	0.93	0.10	2.7
2I3	1.4	7.3	8.1	5.3	1.2	1.2	3.3
2J3	0.99	4.8	4.1	2.4	0.09	0.99	2.9
2L3	0.79	3.7	3.1	1.9	0.72	0.88	2.5
3A3	0.99	6.3	4.2	3.2	1.1	1.3	3.4
3B3	1.7	0.95	0.63	4.2	1.4	1.7	3.7
3D3	2.2	14.	13.	0.55	1.8	1.9	5.3
3E3	1.3	6.1	4.3	2.8	1.2	1.1	3.1
3I3	2.0	9.0	7.3	5.0	1.8	1.9	5.1
3J3	1.9	9.0	7.15	4.6	1.7	1.7	4.8
3L3	0.91	4.4	4.57	3.3	1.2	0.14	4.0
4B3	1.1	6.8	0.46	3.0	1.0	1.1	2.9
4D3	1.4	8.3	5.7	3.7	1.2	1.2	3.3
4E3	1.3	6.3	4.9	3.0	0.12	1.3	3.4
4G3	1.9	9.8	7.5	4.9	1.7	1.8	4.8
4I3	1.4	7.6	4.87	3.4	1.2	1.3	3.6
4J3	1.2	6.7	5.0	3.3	1.1	0.13	3.2
4L3	0.78	4.18	3.35	2.0	0.81	0.89	2.5

TABLE IV. (Continued)

POSITION	U235 (10^{11} n/cm^2)	PU (10^{11} n/cm^2)	NP (10^{11} n/cm^2)	U238 (10^{11} n/cm^2)	S (10^{10} n/cm^2)	MG (10^9 n/cm^2)	AL (10^9 n/cm^2)
2G4	7.1	5.0	4.4	2.1	5.9	3.2	1.8
3E4	12.	5.4	7.8	2.4	9.2	4.8	2.5
3G4	9.3	4.3	6.1	2.2	6.6	3.7	2.0
3H4	8.8	4.6	3.5	2.3	7.8	8.2	2.2
3J4	8.4	6.0	5.8	3.0	8.2	4.8	2.5
3L4	7.4	5.7	3.1	1.9	6.8	3.9	2.6
4B4	2.8	4.1	4.5	1.8	5.9	3.3	1.7
4D4	9.6	5.1	2.2	1.9	6.9	3.8	1.9
4G4	9.6	4.7	2.9	1.9	5.7	3.5	2.2
4J4	2.7	4.6	3.3	2.0	7.3	4.2	2.6
4L4	5.5	3.6	2.7	1 6	5.8	3.5	1.6
2B5	3.1	2.3	1.8	0.98	4.0	2.3	1.4
2D5	4.9	3.5	3.0	1.7	4.6	1.6	1.4
2G5	5.0	3.4	2.7	1.7	4.7	1.6	1.6
2I5	5.4	3.6	3.2	1.7	4.5	1.6	1.3
2J5	4.4	3.2	2.2	0.13	4.3	2.3	1.2
2L5	3.0	2.0	1.7	0.87	3.4	2.0	0.99
3A5	2.9	2.3	1.5	1.1	3.3	2.0	1.1
3B5	5.2	3.2	3.2	1.38	4.1	2.5	1.4
3C5	4.2	2.9	2.0	1.2	4.5	2.4	1.4
3D5	6.1	3.5	2.7	1.8	0.49	3.0	1.3
3E5	5.8	3.7	3.2	2.2	5.1	2.9	1.6
3F5	4.1	3.4	2.5	1.4	4.6	2.5	1.3
3G5	6.6	4.5	3.3	2.1	4.5	2.1	1.6
3H5	6.8	2.6	3.4	1.1	4.7	2.4	1.4

TABLE IV. (Continued)

POSITION	U235 $(10^{11}\ n/cm^2)$	PU $(10^{11}\ n/cm^2)$	NP $(10^{11}\ n/cm^2)$	U238 $(10^{11}\ n/cm^2)$	S $(10^{10}\ n/cm^2)$	MG $(10^9\ n/cm^2)$	AL $(10^9 n/cm^2)$
3I5	5.9	3.4	2.7	1.7	5.8	2.9	1.5
3J5	6.1	3.6	2.8	1.8	5.0	2.7	1.3
3K5	6.1	4.6	2.0	3.0	4.4	2.4	1.3
3L5	4.2	2.7	1.9	1.1	4.6	2.4	1.4
3M5	2.8	1.9	2.0	0.86	2.5	1.8	1.0
4B5	3.8	2.4	1.8	1.8	3.9	2.2	1.1
4D5	4.7	2.8	1.9	1.2	4.3	2.3	1.4
4G5	5.1	3.2	2.9	1.7	4.7	1.5	1.3
4J5	6.9	4.9	3.2	1.1	4.2	2.5	1.4
4L5	3.4	2.1	1.7	0.98	3.7	2.4	*

POSITION	U235 $(10^{11}\ n/cm^2)$	PU $(10^{11}\ n/cm^2)$	NP $(10^{11}\ n/cm^2)$	U238 $(10^{10}\ n/cm^2)$	S $(10^{10}\ n/cm^2)$	MG $(10^9\ n/cm^2)$	AL $(10^8 n/cm^2)$
1J6	2.0	1.7	1.0	6.6	1.4	0.81	4.4
2D6	2.9	2.0	1.4	9.2	2.1	1.5	*
2E6	3.0	2.2	1.2	10.	2.3	1.4	6.9
2G6	2.3	2.2	1.4	7.2	2.0	1.1	*
2I6	3.1	2.2	1.5	8.0	2.2	1.4	5.3
2J6	3.0	2.4	1.6	9.3	2.2	1.5	*
3D6	2.4	2.1	1.2	4.6	1.8	0.97	*
3E6	2.0	1.7	0.94	6.6	1.9	1.0	6.0
3G6	2.3	2.1	0.88	6.8	1.8	0.86	4.7
3I6	2.0	1.9	1.2	7.2	1.8	0.94	4.6
3J6	2.1	1.7	0.68	3.8	1.8	0.86	4.7
4D6	2.8	2.1	1.4	8.5	2.2	1.4	4.8

TABLE IV (Continued)

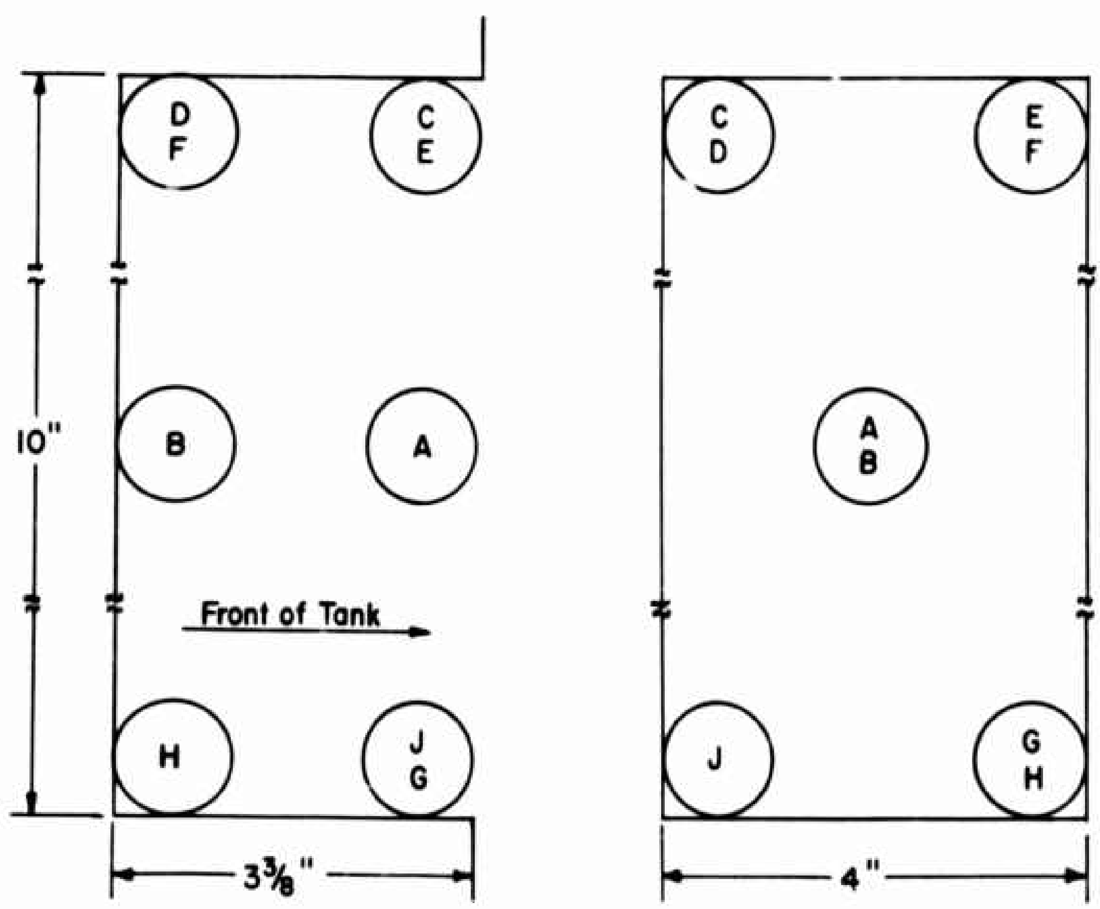
Position	U235 (10^{11} n/cm^2)	PU (10^{11} n/cm^2)	NP (10^{11} n/cm^2)	U238 (10^{10} n/cm^2)	S (10^{10} n/cm^2)	MG (10^9 n/cm^2)	AL (10^8 n/cm^2)
4E6	3.3	2.5	1.7	11.	2.3	1.1	6.3
4G6	2.7	2.2	1.6	7.7	2.1	1.0	5.7
4I6	2.9	2.3	1.3	9.1	2.2	1.5	*
4J6	2.9	2.1	1.5	11.	2.2	1.2	5.9
5J6	2.0	1.4	0.92	5.8	1.4	0.83	4.0

POSITION	U235 (10^{11} n/cm^2)	PU (10^{11} n/cm^2)	NP (10^{10} n/cm^2)	U238 (10^{10} n/cm^2)	S (10^{10} n/cm^2)	MG (10^8 n/cm^2)	AL (10^8 n/cm^2)
2D7	1.6	1.1	6.5	3.8	1.5	5.7	2.6
2E7	1.6	1.1	5.9	4.9	1.2	5.2	3.5
2G7	1.5	1.4	4.1	3.6	2.2	5.9	2.3
2I7	1.4	1.1	8.6	5.3	1.2	5.1	2.8
2J7	1.7	1.2	5.6	4.5	1.0	4.7	4.1
3D7	1.9	1.5	6.1	6.4	1.3	9.4	*
3E7	1.8	1.6	11.	5.4	1.4	13.7	*
3G7	1.8	1.4	9.2	5.7	1.3	7.2	*
3I7	2.2	1.5	11.	5.6	1.4	11.	*
3J7	2.3	1.5	8.2	5.2	1.3	9.3	*
4D7	1.4	1.1	6.1	4.5	1.2	5.3	3.1
4E7	1.4	1.2	5.4	4.8	1.1	5.8	4.3
4G7	1.4	1.1	8.1	3.8	1.1	6.1	3.6
4I7	1.6	1.3	4.6	4.0	1.2	6.0	*
4J7	1.4	1.2	4.9	3.6	10.	5.2	2.7

*Detector sensitivity insufficient to detect dose or detector background too high to detect dose.

TABLE V. NEUTRON FLUENCE IN DIMPLE, $2.65 PULSE

DETECTOR	PU 239 (n/cm²)	NP 237 (n/cm²)	U238 (n/cm²)	S (n/cm²)
A	6.8×10^{13}	5.3×10^{13}	2.8×10^{13}	7.9×10^{12}
B	1.9×10^{14}	1.4×10^{14}	5.1×10^{13}	1.1×10^{13}
C	6.5×10^{13}	4.4×10^{13}	2.5×10^{13}	5.3×10^{12}
D	1.3×10^{14}	8.8×10^{13}	5.5×10^{13}	8.8×10^{12}
E	6.2×10^{13}	3.8×10^{13}	2.7×10^{13}	1.1×10^{13}
F	1.4×10^{14}	1.0×10^{14}	5.0×10^{13}	9.9×10^{12}
G	6.9×10^{13}	4.6×10^{13}	2.6×10^{13}	5.1×10^{12}
H	1.6×10^{14}	9.8×10^{13}	5.1×10^{13}	9.5×10^{12}
J	4.8×10^{13}	4.5×10^{13}	2.2×10^{13}	9.2×10^{12}



SIDE VIEW FRONT VIEW

TABLE VI. STEADY-STATE DOSE RATES IN POOL

Position	Power Level (kw)	Time (min)	Gamma Exposure Rate (R/kw-hr)	Neutron Dose Rate (n/cm^2/kw-hr)
Fast Neutrons (>3.0 Mev)				
At core window	250	30	-	1.2×10^{10}
1/2 in. from core window	250	30	-	9.7×10^{9}
Thermal Neutrons				
1 in. from shroud	8	25	1.4×10^{4}	1.6×10^{12}
1 in. from shroud	60	25	1.9×10^{4}	6.9×10^{12}

TABLE VII. STEADY-STATE NEUTRON FLUENCE AND EXPOSURE RATE IN EXPOSURE ROOM

Position	Energy (kev)	Power Level (kw)	Time (min)	Fluence (n/cm^2)	Exposure Rate (n/cm^2/kw-hr
Dimple	>3000	varied	varied	-	9.8×10^{11}
3G2	>1.5	250	10	2.3×10^{13}	5.4×10^{11}
3G2	>10	250	10	1.7×10^{13}	4.1×10^{11}
3G2	>600	250	10	1.3×10^{13}	3.1×10^{11}
3G2	>1500	250	10	7.1×10^{12}	1.7×10^{11}
3G2	>3000	250	10	2.5×10^{12}	6.0×10^{10}
3G2	>6100	250	10	1.4×10^{11}	3.4×10^{9}
3G2	>8300	250	10	8.3×10^{10}	2.0×10^{9}

REMARKS ON THE DATA

1. General

a. The lines between the data points of figures 11-27, 50-72 and 111-123 are drawn to guide the reader's eye. It is not unreasonable, however, to expect the radiation field to generally follow those lines.

b. Due to the large number of points measured and the limited number of detectors available, the re-use of foils before a sufficient decay time elapsed produced several apparent anomalies. This was the result of poor statistics due to high background.

c. The NDL personnel calculated fluences from count rates which were very close to background whether or not the detector was re-used. Hence, although generally 10^9 n/cm^2 is referred to as the minimum sensitivity of most of the foils, some fluences below this value are reported. These fluences have a reproducibility of about ±25 percent and a proportionally lower accuracy.

d. Due to the 12 in. thick wood lining of the exposure room, some apparent anomalies resulted for detectors placed near the walls. These can best be termed "boundary effects."

e. The smooth curves drawn through the data representing the vertical fast neutron gradient in both the pool and exposure room are based on theoretical considerations and represent the best estimate of neutron fluence variation with height.

f. Error flags, as shown on typical figures 85 and 94, demonstrate that what seems to be an anomalous condition is probably the result of the inherent statistical error in the threshold detector system for the determination of neutron spectra.

Figure 12. The fluence present at the final point is near the lower limit of sensitivity due to prior use of the foils. The apparent anomaly is the result of statistical uncertainty.

Figure 15. The points are so close together at the 10-inch distance that the error limits result in an overlap of the values.

Figures 19, 20, and 21. The fluence present at the more distant points is near the sensitivity limit of the detectors. Statistical uncertainty is greatly increased as a result.

Figure 22. The overlap is the result of the points bunching. The data are good considering the error limits.

Figure 24. The U-238 data point at 20 in. is probably in error due to the fluence being near its sensitivity limit.

Figure 25. The Np-237 data point at 25 in. is in error due to the fluence approaching its sensitivity limit.

Figure 27. The Np-237 and U-238 points at 10 in. are within the error limits of each other.

Figure 30. The apparent overlap is due to the data of Pu 239 and Np 237 being within each others error limits at the 29 in. height.

Figures 37 and 41. The nearness of the Pu 239 and Np 237 data points causes an apparent overlap which does not, in fact, occur.

Figures 45, 46, 47, 48, and 49. The data are highly suspect due to the fluence approaching the detector sensitivity. Dashed lines represent extrapolation.

Figures 50-56 and 66-72. The peak is a result of the slant height angle through which the detector viewed the core changing as the detector was moved away from the core. At the nearer distance, there was more water between the detector and the active volume of the core, hence a lower dose was delivered to that point due to the shielding effect of the water.

Figure 56. The overlap at 21 in. of Pu 238, Np 237, and U-238 is due to the closeness of the data points and the allowable error limit.

Figure 60. The apparent scatter can only be attributed to the anomalies that occasionally arise in any statistical system.

Figures 61, 66. The overlap is within the error limits of the data.

Figure 67. No data available at 20 in. Dashed line represents estimate from other radial data taken.

Figure 72. Data overlap is caused by statistical variation and is hence within the 25-percent error limit.

Figures 74-95. Overlap of data points does not really occur due to an accuracy of ±25 percent, which must be considered for all data points. Dashed lines represent extrapolation.

Figures 98-110. Distribution shifts are due to boundary effects coupled with distance from the radiation source.

Figure 115. Except for sulfur, all data were taken at the 22-inch distance from the thimble.

Figure 119-123. Since the data are taken from another source, they are reported herein as shown in the original work.

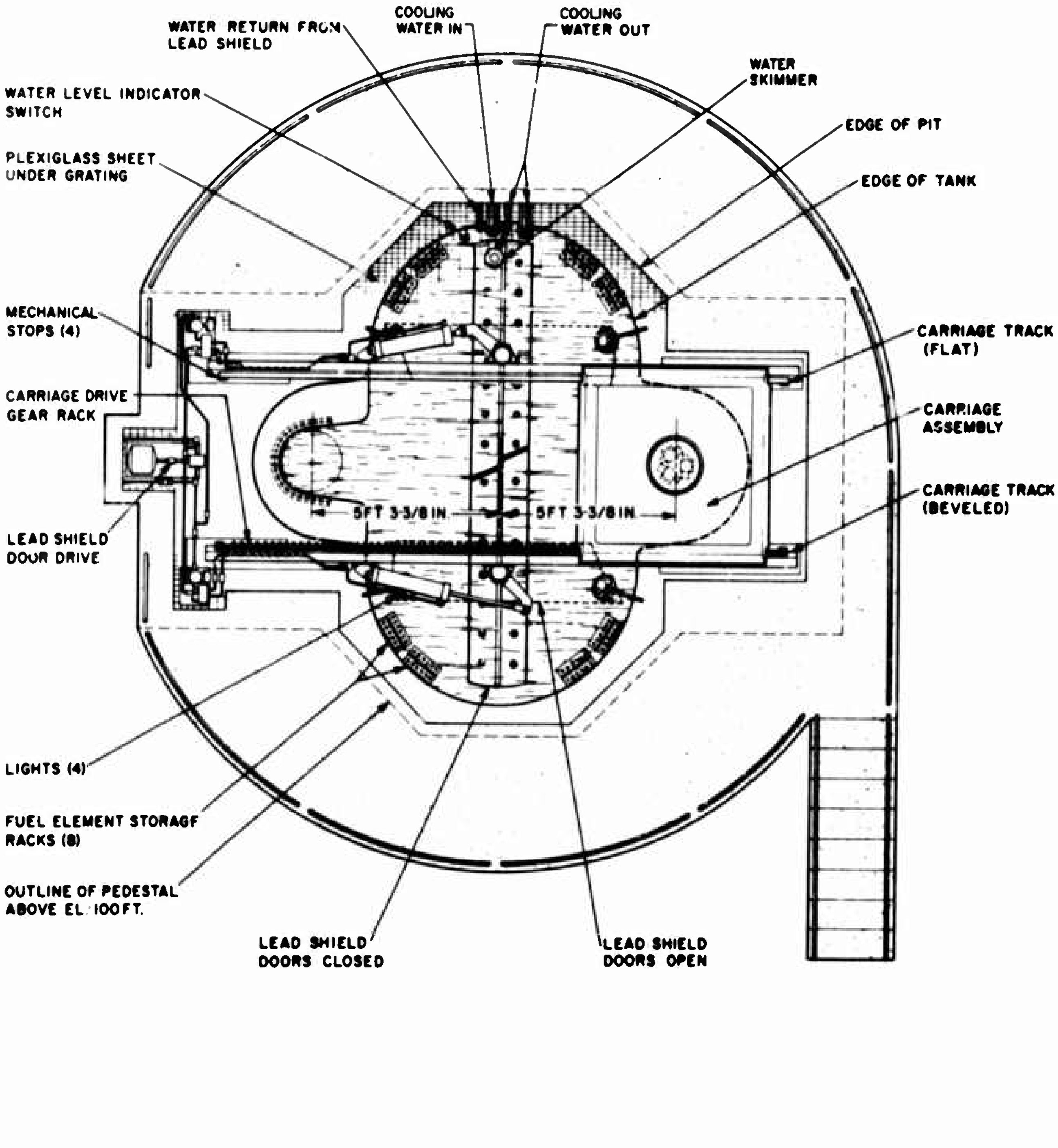


FIGURE 1. PLAN VIEW OF DORF REACTOR

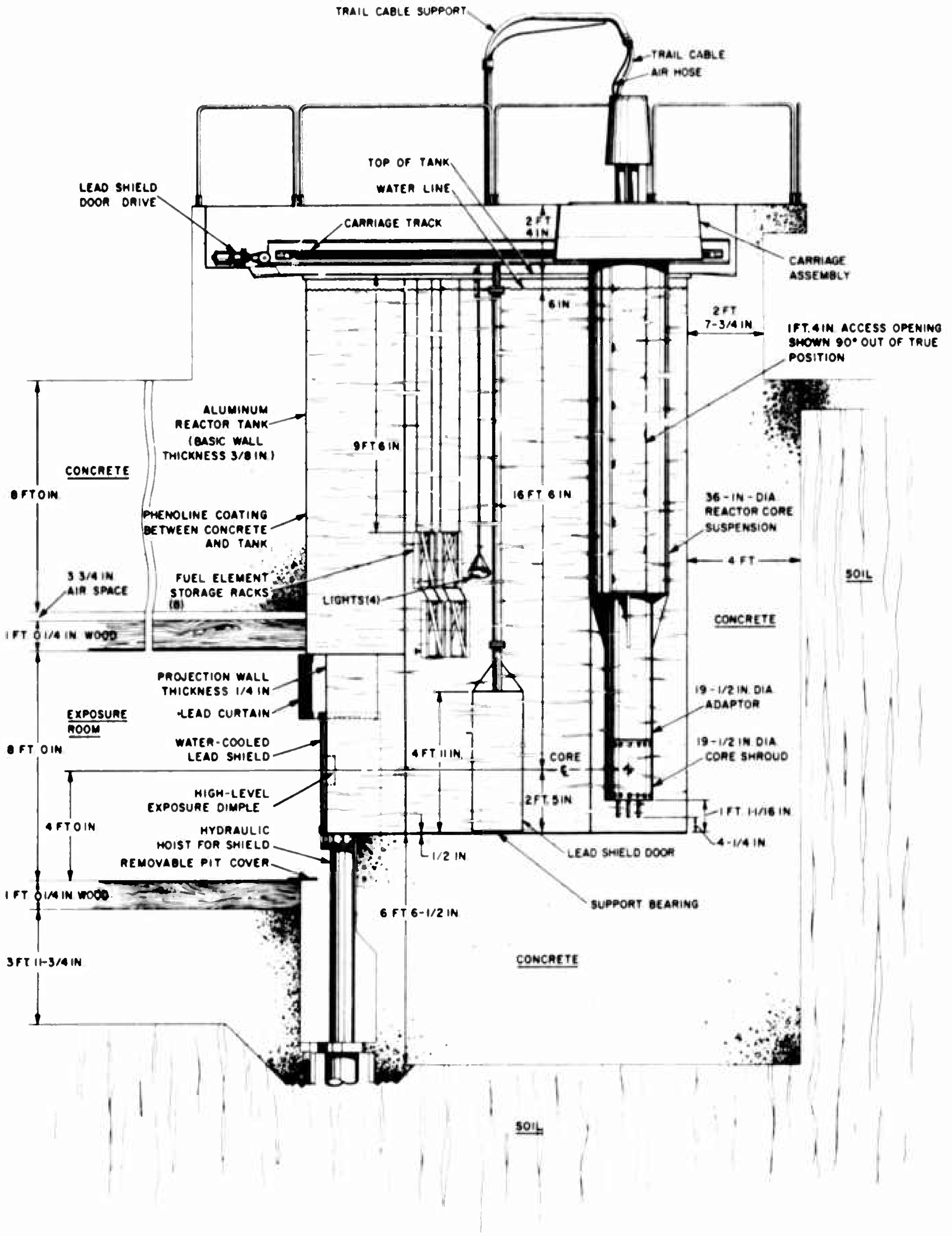


FIGURE 2. SECTIONAL ELEVATION OF DORF REACTOR

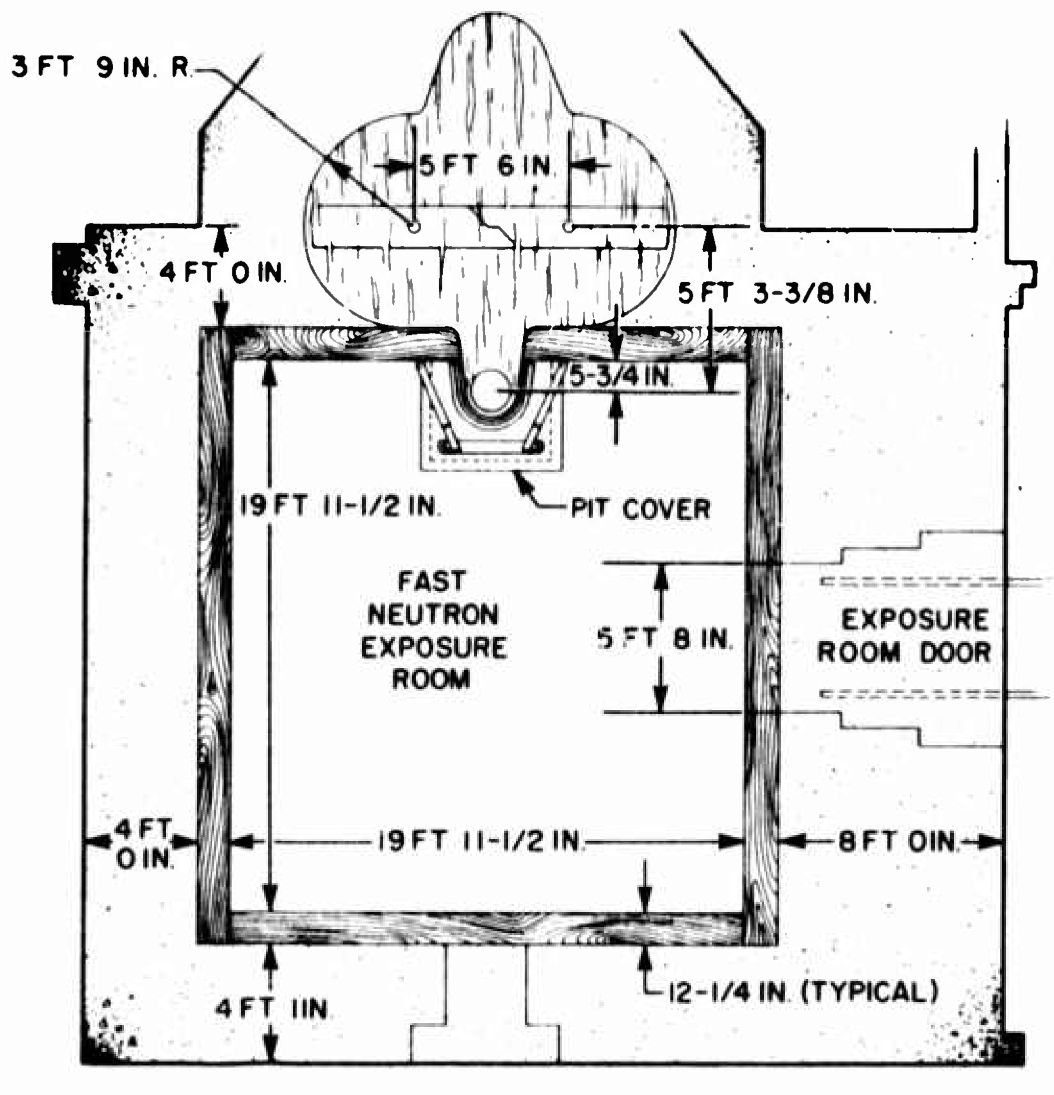


FIGURE 3. PLAN VIEW OF DORF EXPOSURE ROOM

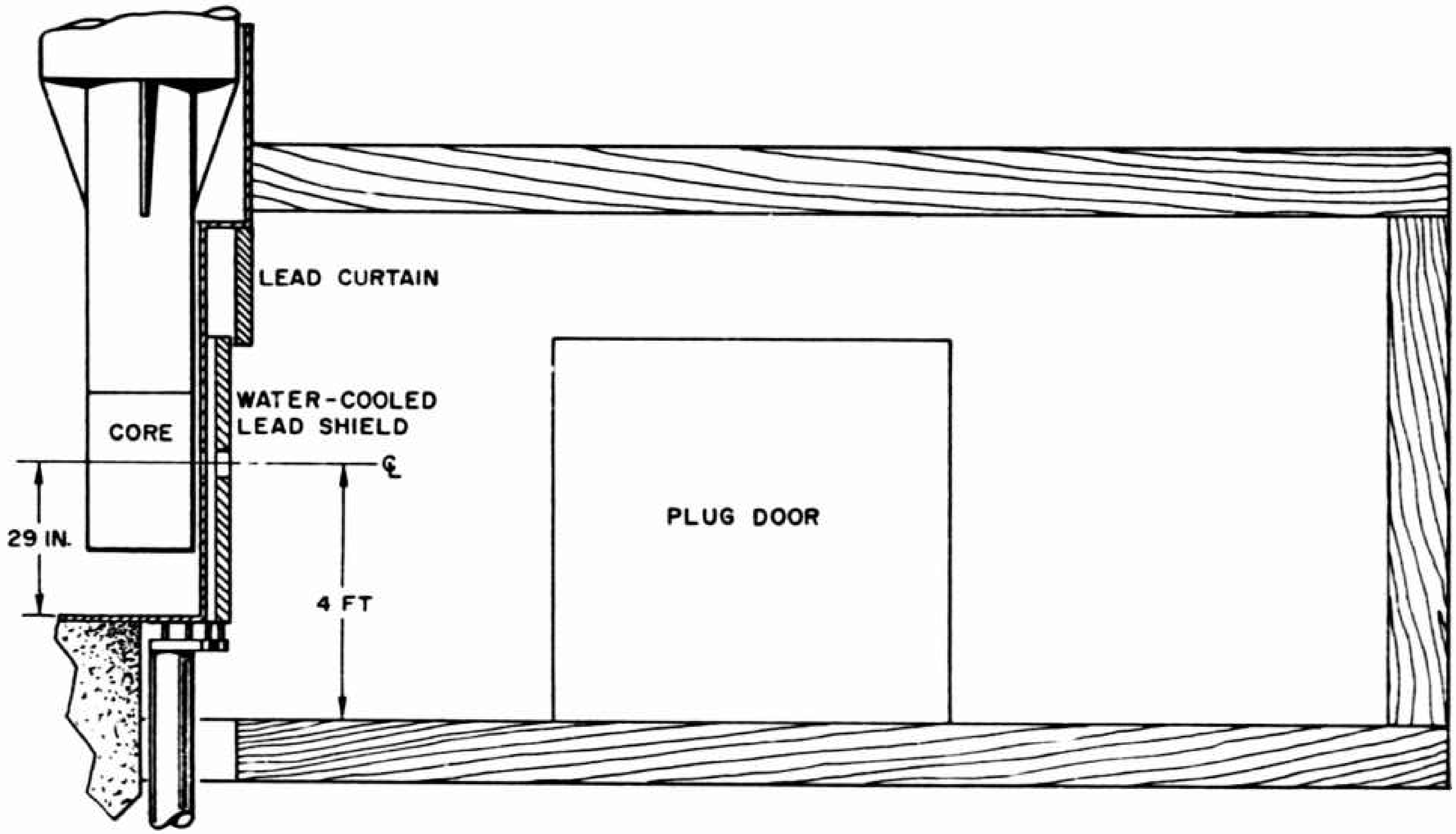


FIGURE 4. ELEVATION VIEW OF EXPOSURE ROOM

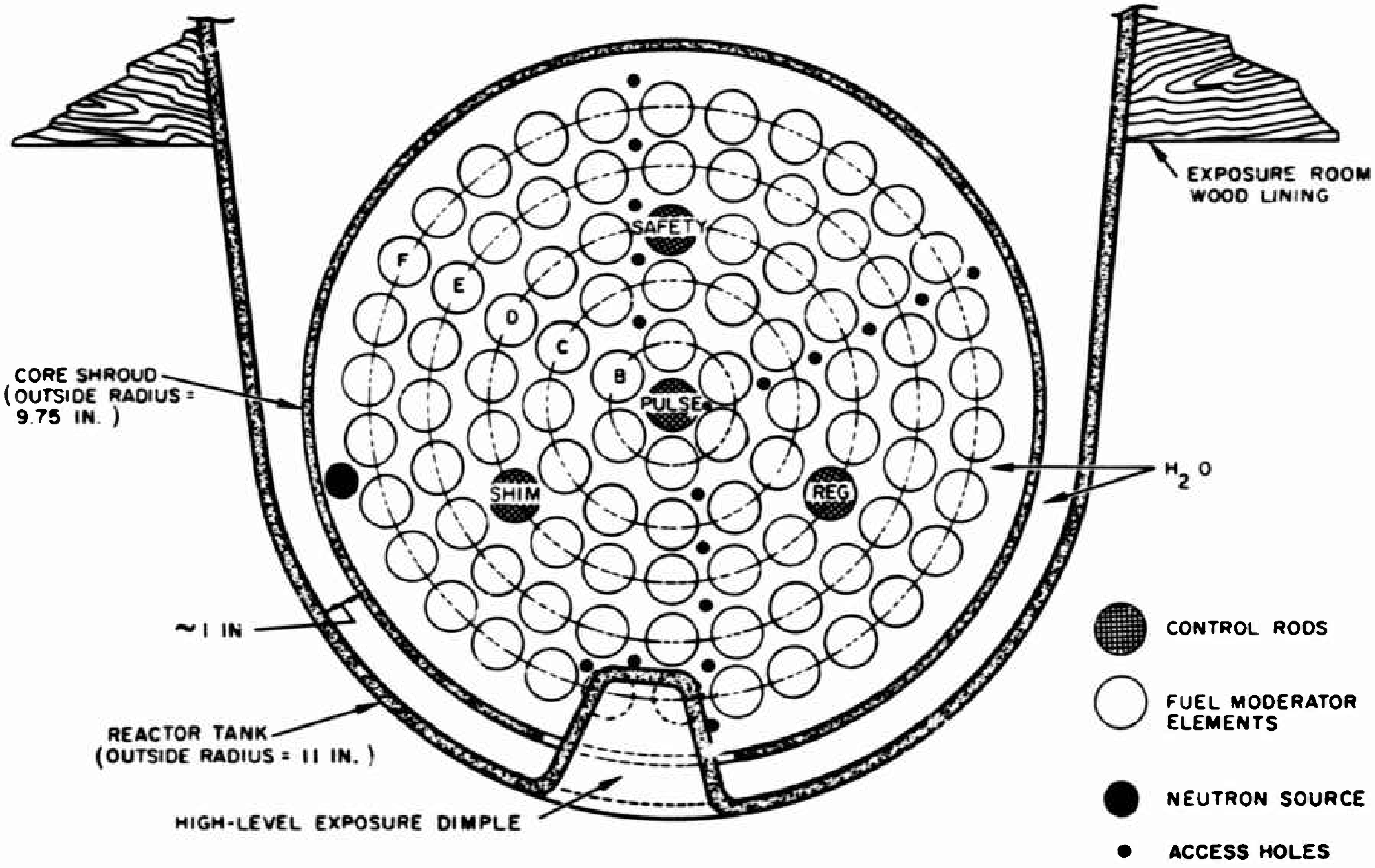


FIGURE 5. HIGH-LEVEL-EXPOSURE DIMPLE

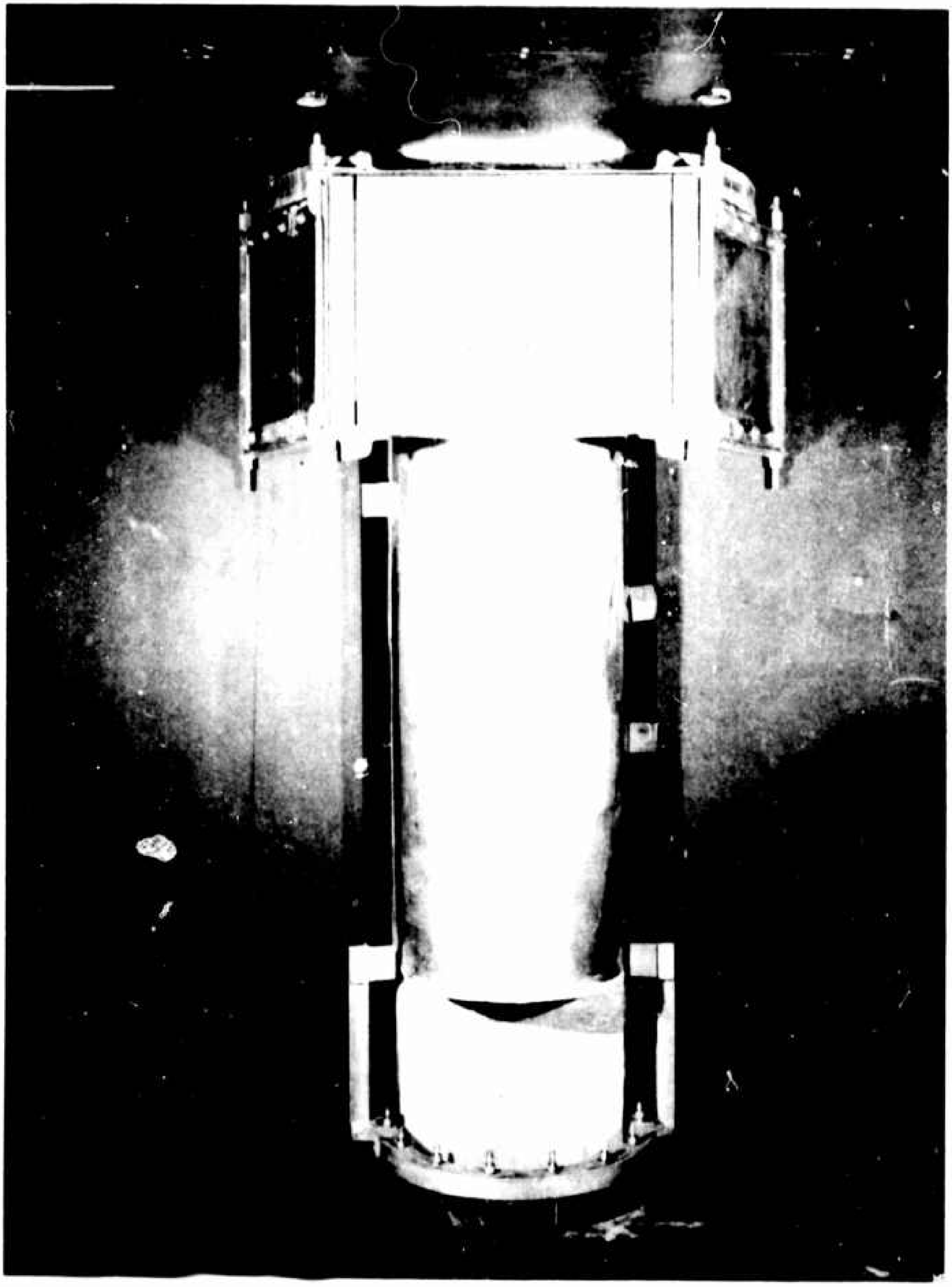
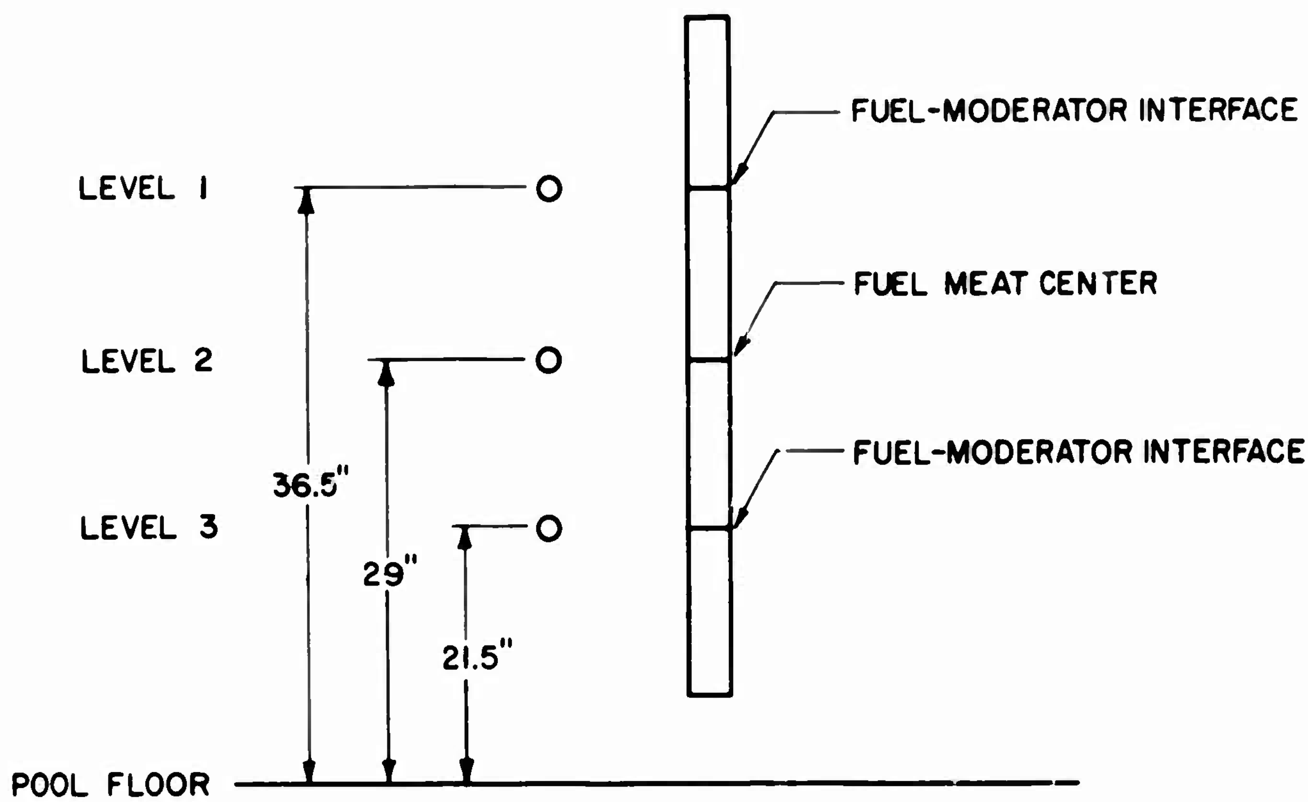


FIGURE 6. HIGH-LEVEL EXPOSURE DIMPLE IN REACTOR TANK WALL AS SEEN FROM EXPOSURE ROOM



NOTE:
Relative position between dosimeters and fuel not to scale.

FIGURE 7. POOL MAPPING DIAGRAM ELEVATION

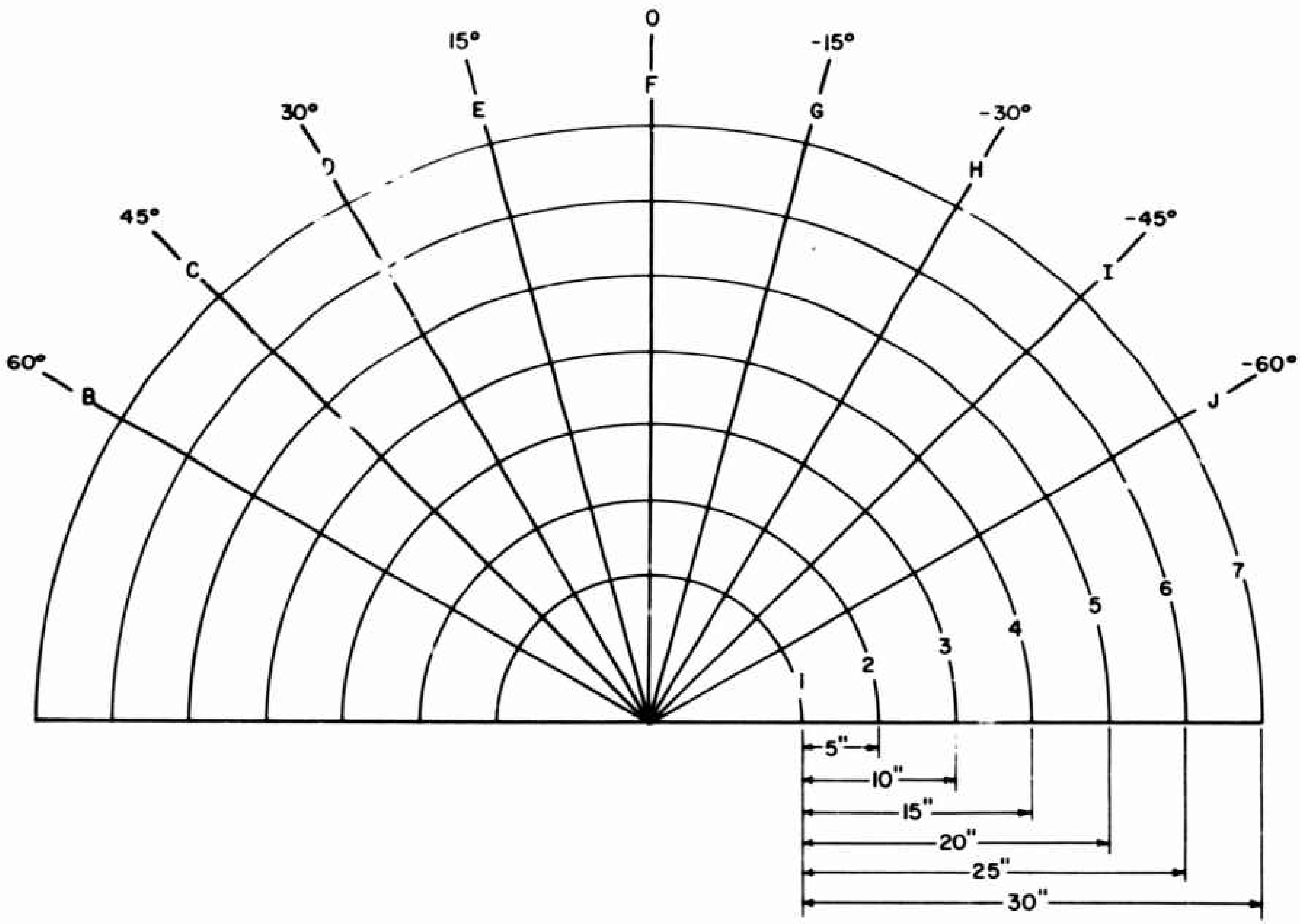


FIGURE 8. PLAN VIEW OF REACTOR POOL DOSIMETER PLACEMENT GRID

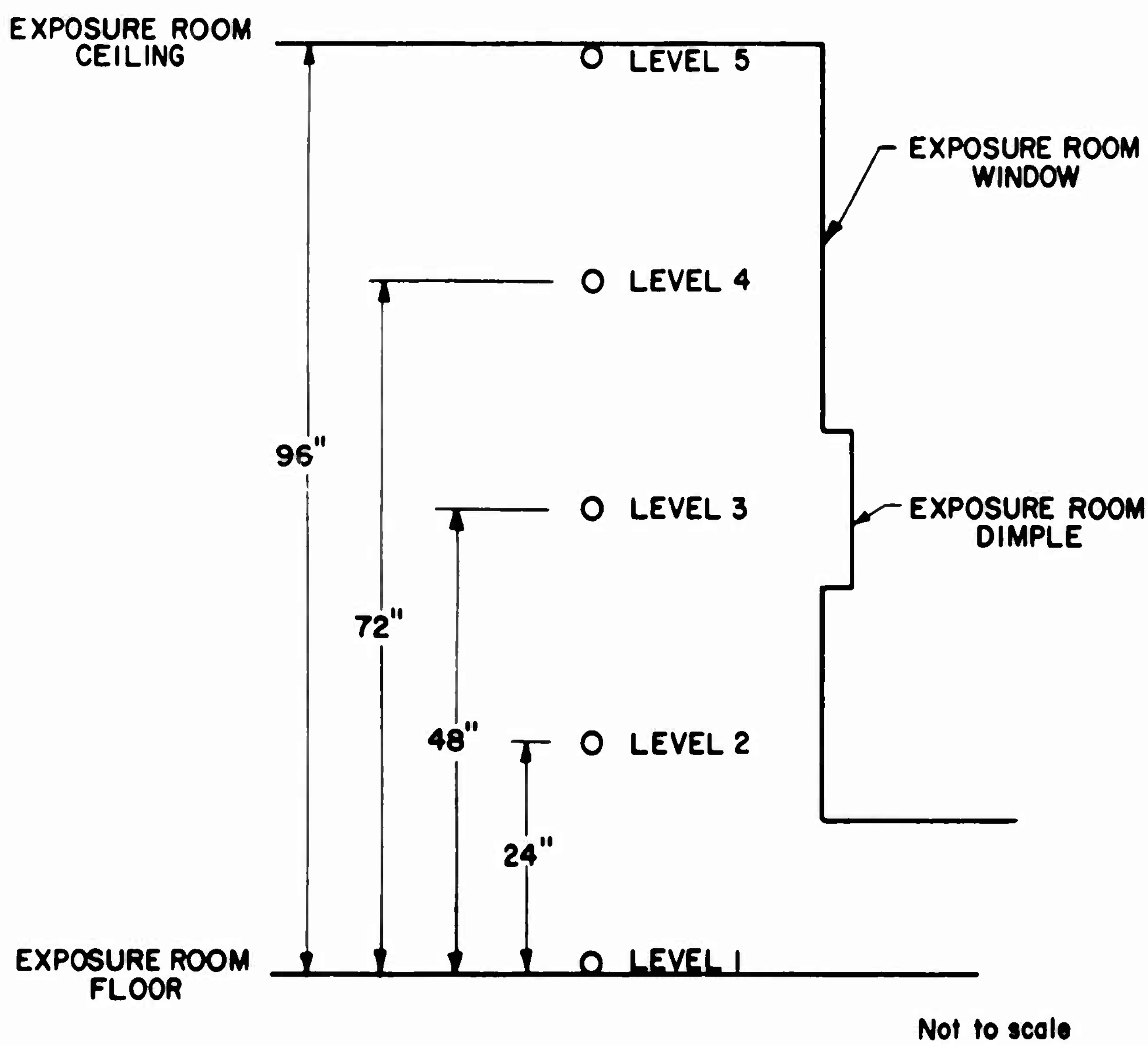


FIGURE 9. EXPOSURE ROOM MAPPING DIAGRAM ELEVATION

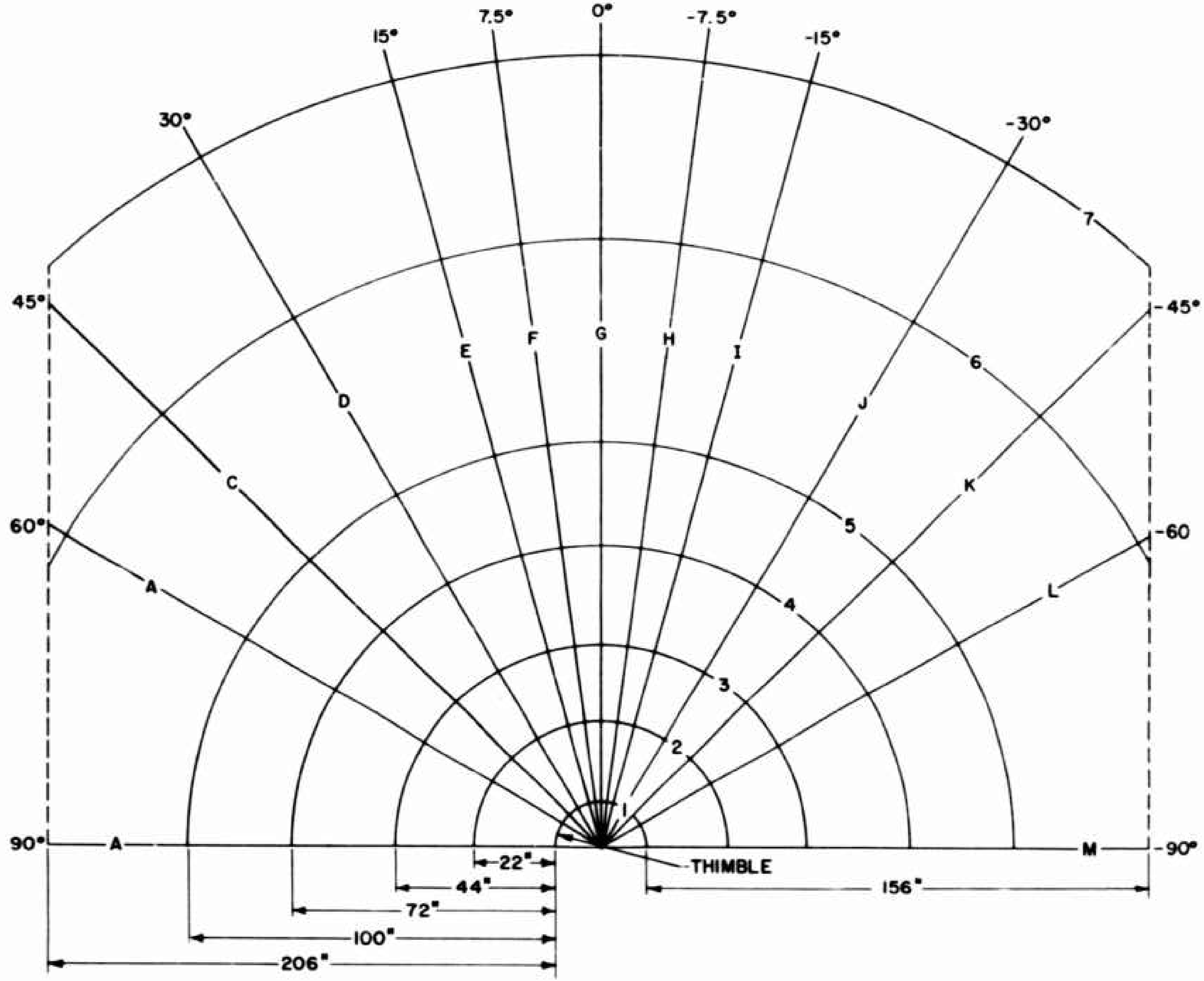


FIGURE 10. PLAN VIEW OF EXPOSURE ROOM DOSIMETER LOCATING GRID

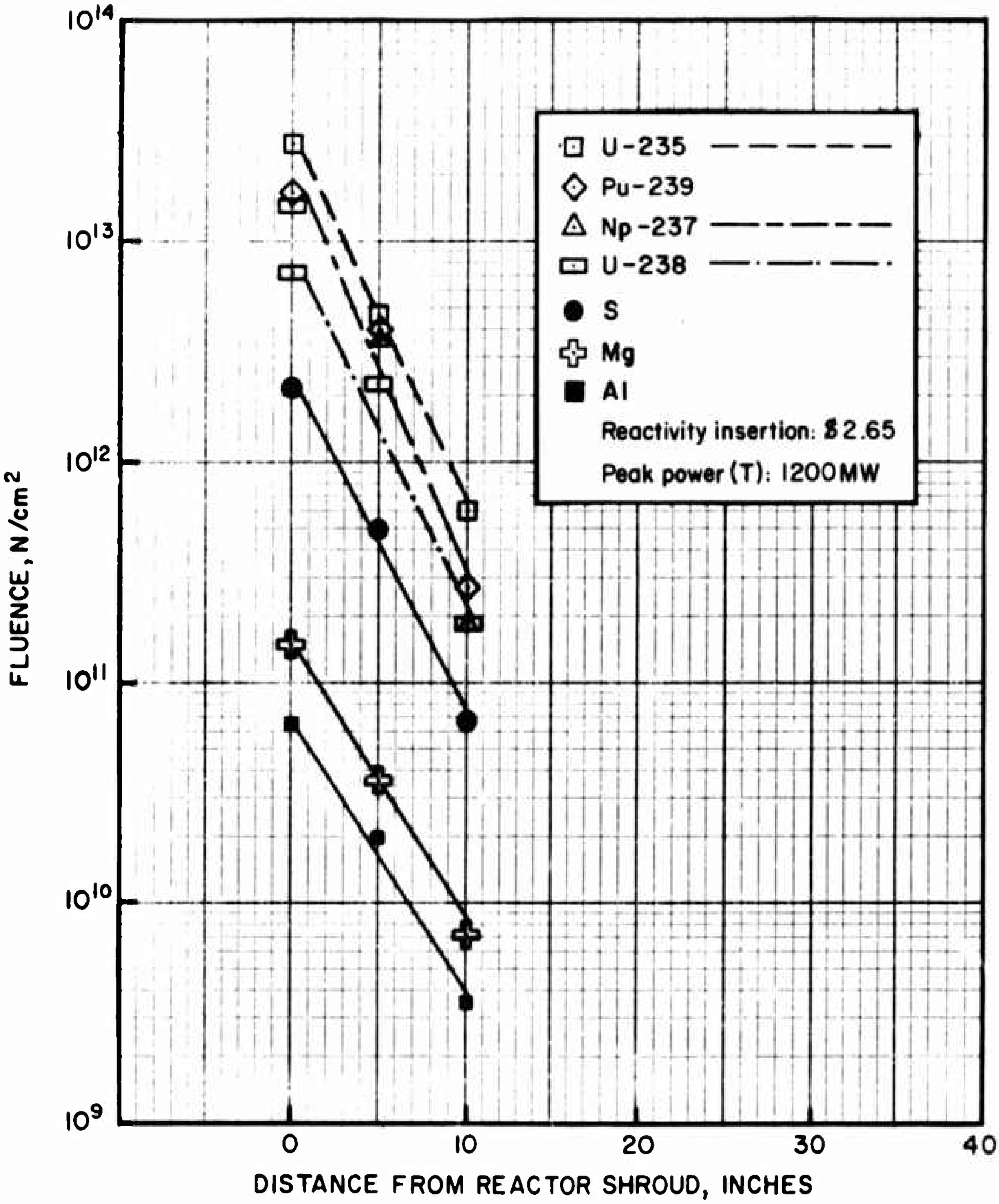


FIGURE 11. POOL RADIAL FAST NEUTRON GRADIENT, 60° FROM POOL MIDLINE (SEE FIGURE 8), 36.5 INCHES ABOVE POOL FLOOR.

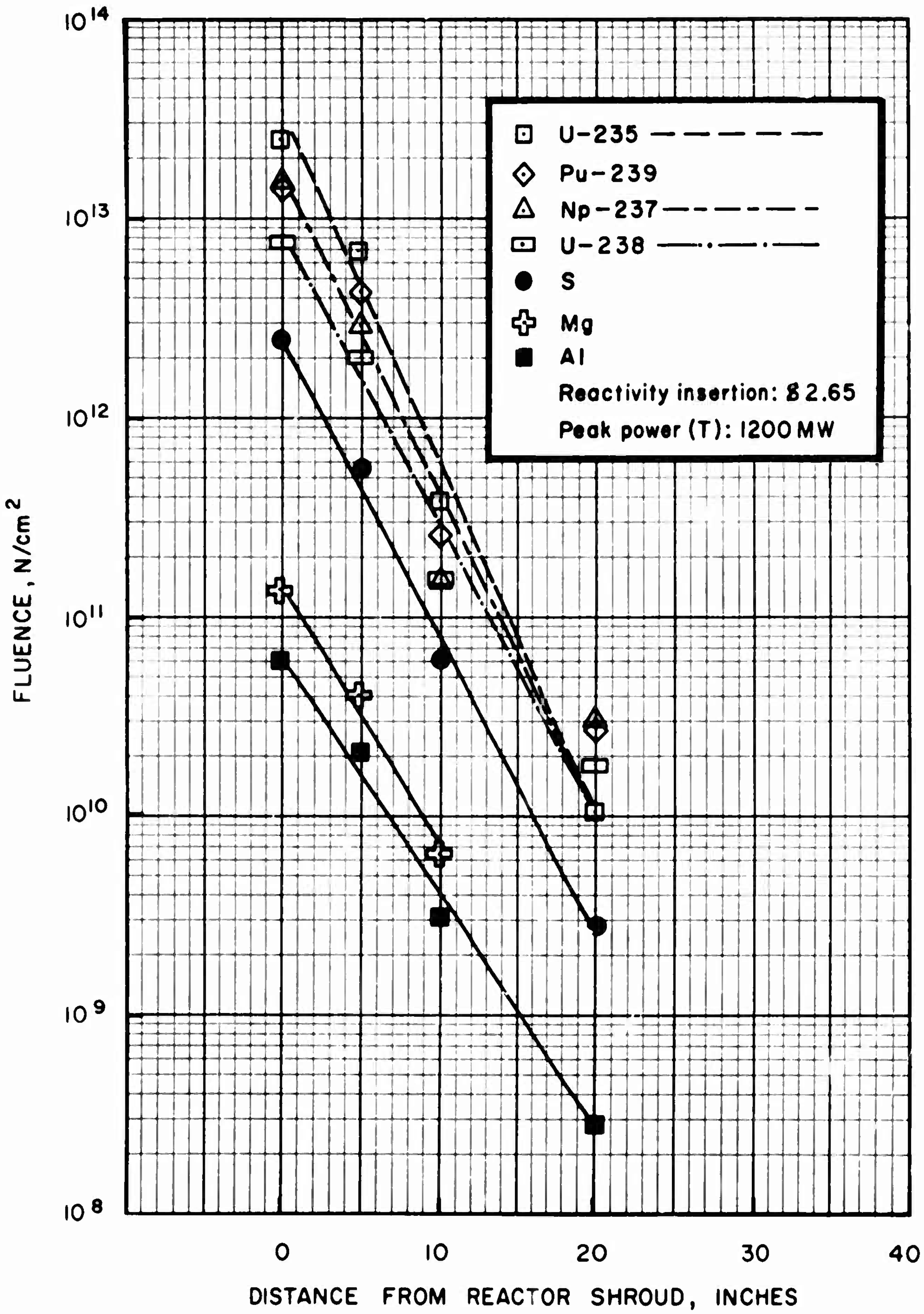


FIGURE 12. POOL RADIAL FAST NEUTRON GRADIENT 30° FROM POOL MIDLINE (SEE FIGURE 8), 36.5 INCHES ABOVE POOL FLOOR.

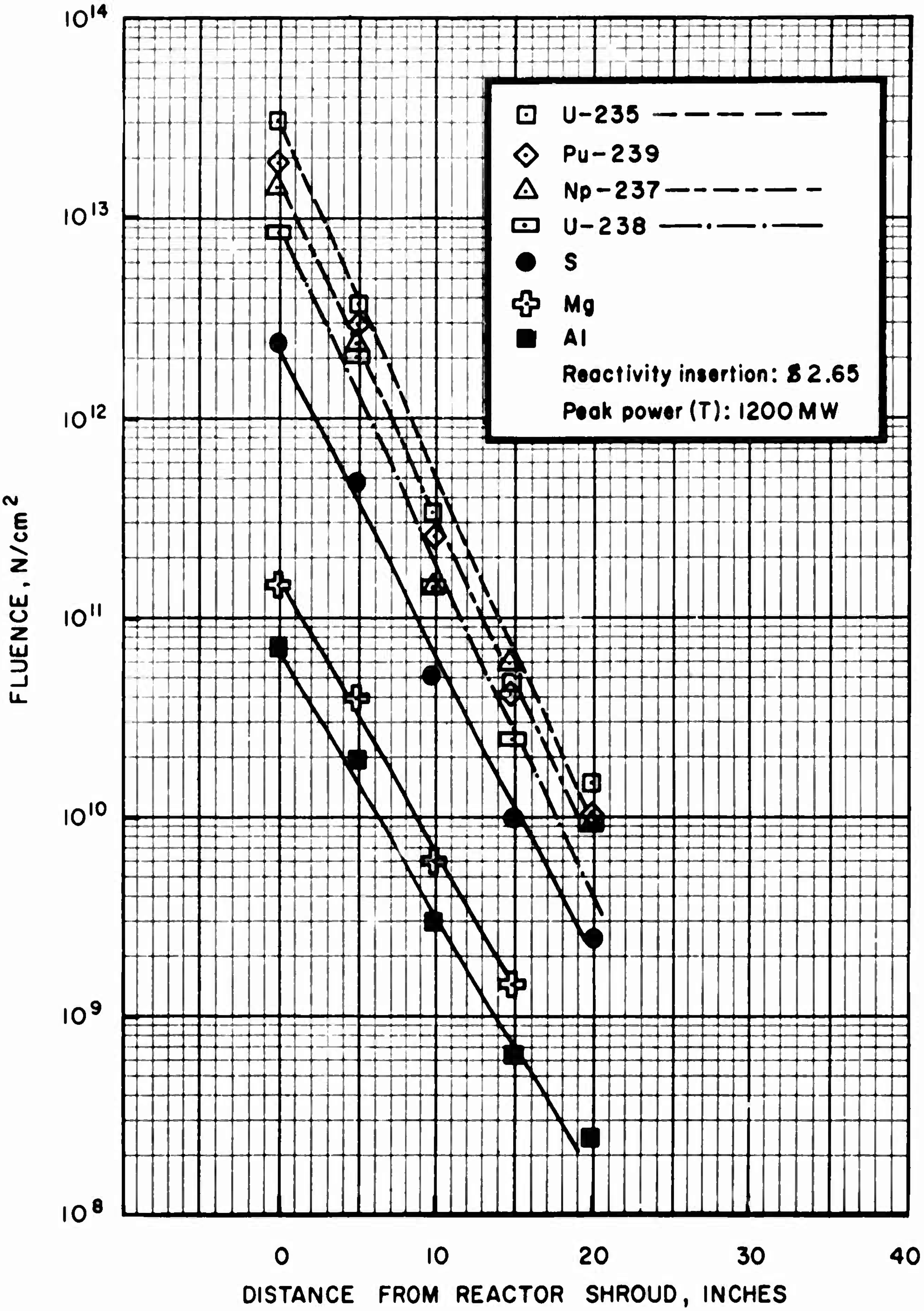


FIGURE 13. POOL RADIAL FAST NEUTRON GRADIENT, AT MIDLINE OF POOL, (SEE FIGURE 8), 36.5 INCHES ABOVE POOL FLOOR.

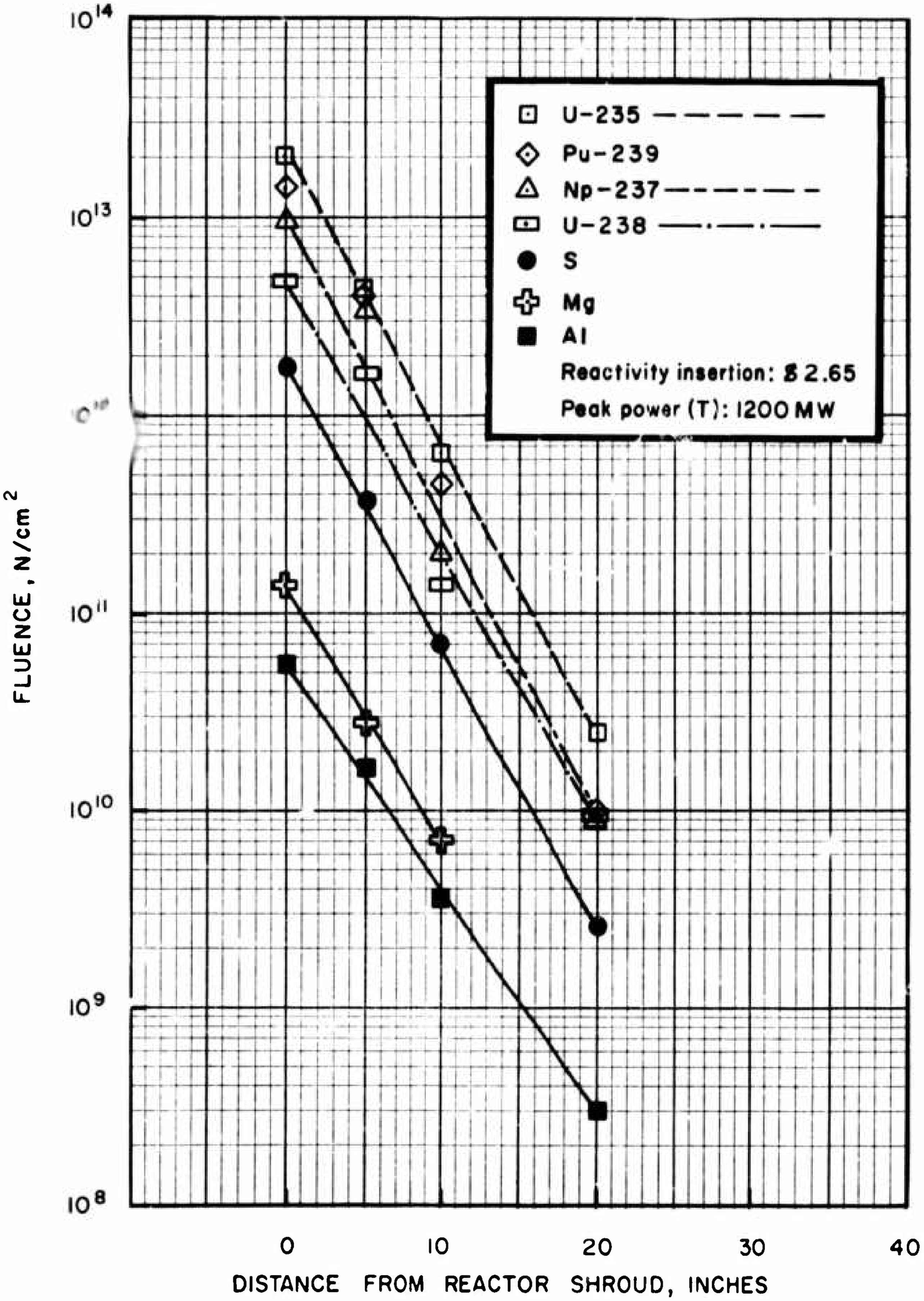


FIGURE 14. POOL RADIAL FAST NEUTRON GRADIENT, -30° FROM POOL MIDLINE (SEE FIGURE 8), 36.5 INCHES ABOVE POOL FLOOR.

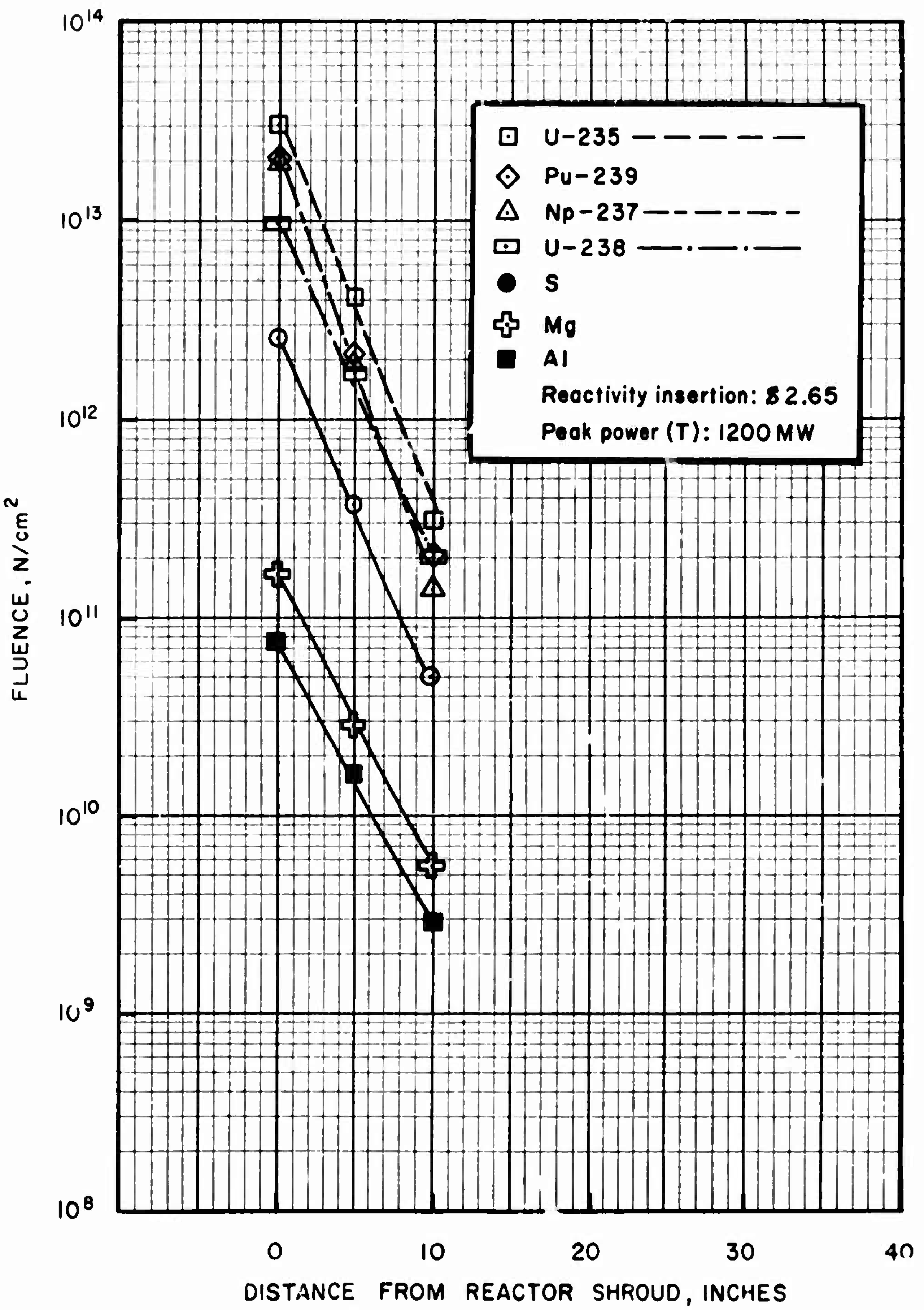


FIGURE 15. POOL RADIAL FAST NEUTRON GRADIENT, -60° FROM POOL MIDLINE (SEE FIGURE 8), 36.5 INCHES ABOVE POOL FLOOR.

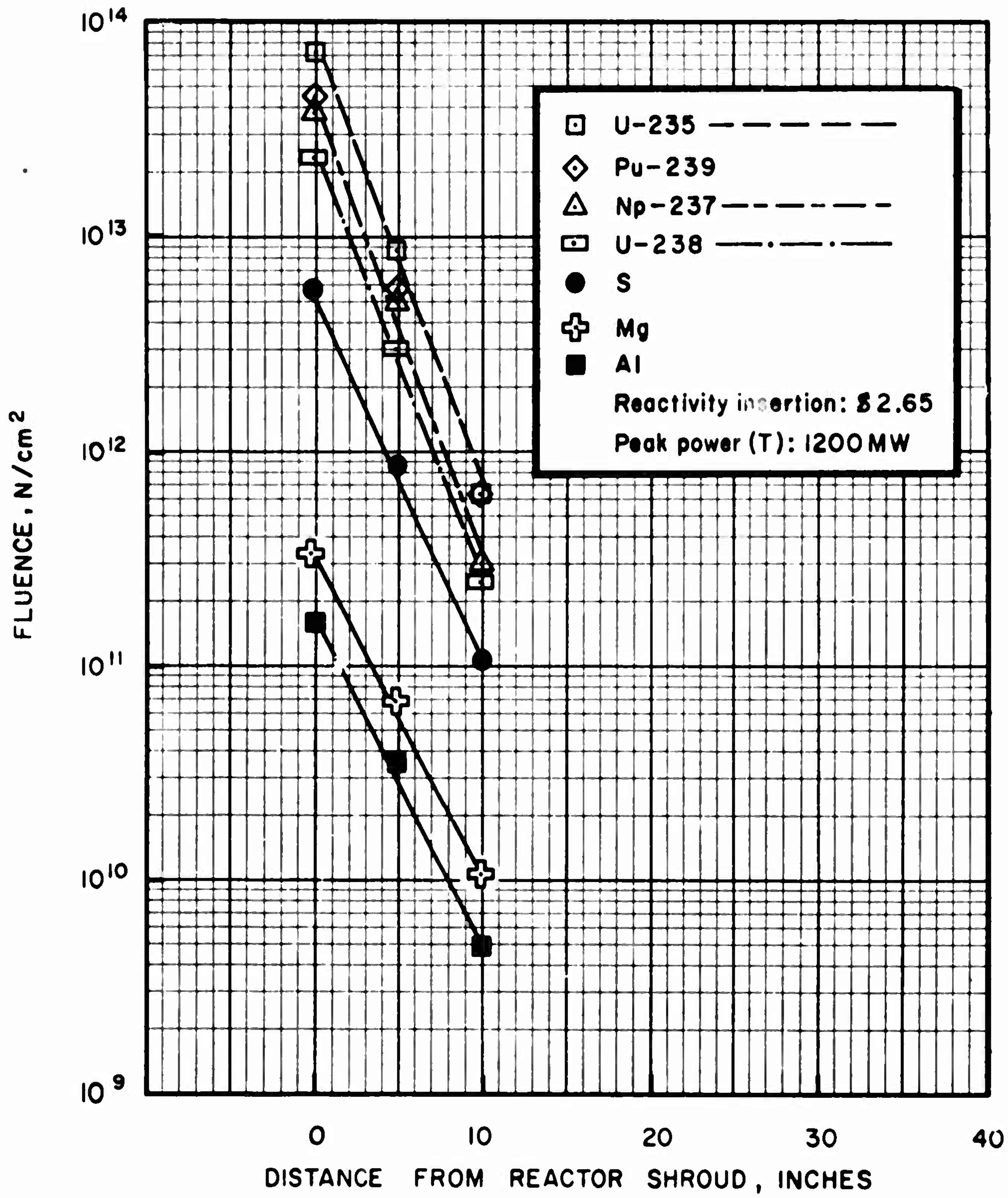


FIGURE 16. POOL RADIAL FAST NEUTRON GRADIENT, 60° FROM POOL MIDLINE (SEE FIGURE 8), 29 INCHES ABOVE POOL FLOOR.

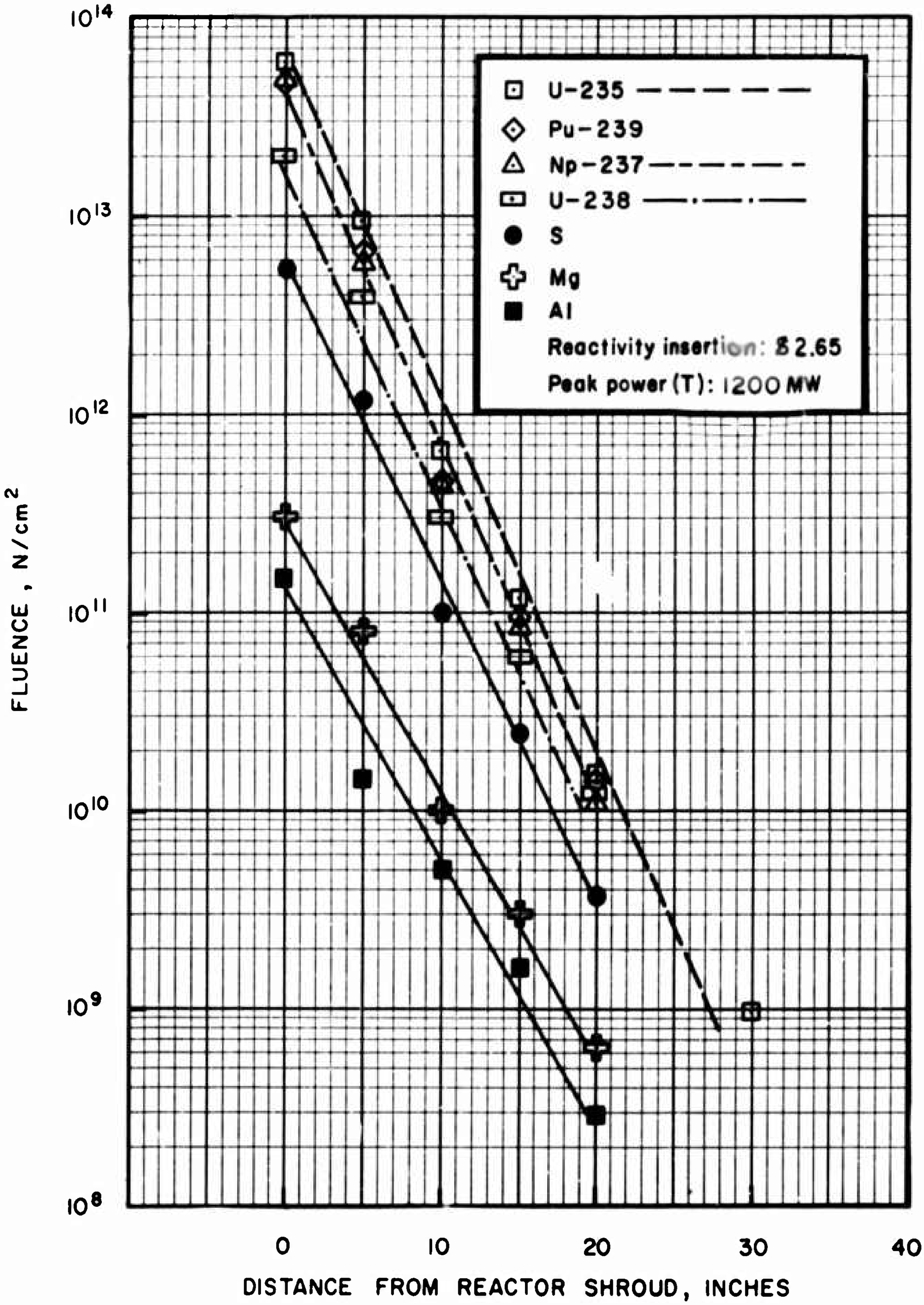


FIGURE 17. POOL RADIAL FAST NEUTRON GRADIENT, 30° FROM POOL MIDLINE, (SEE FIGURE 8), 29 INCHES ABOVE POOL FLOOR.

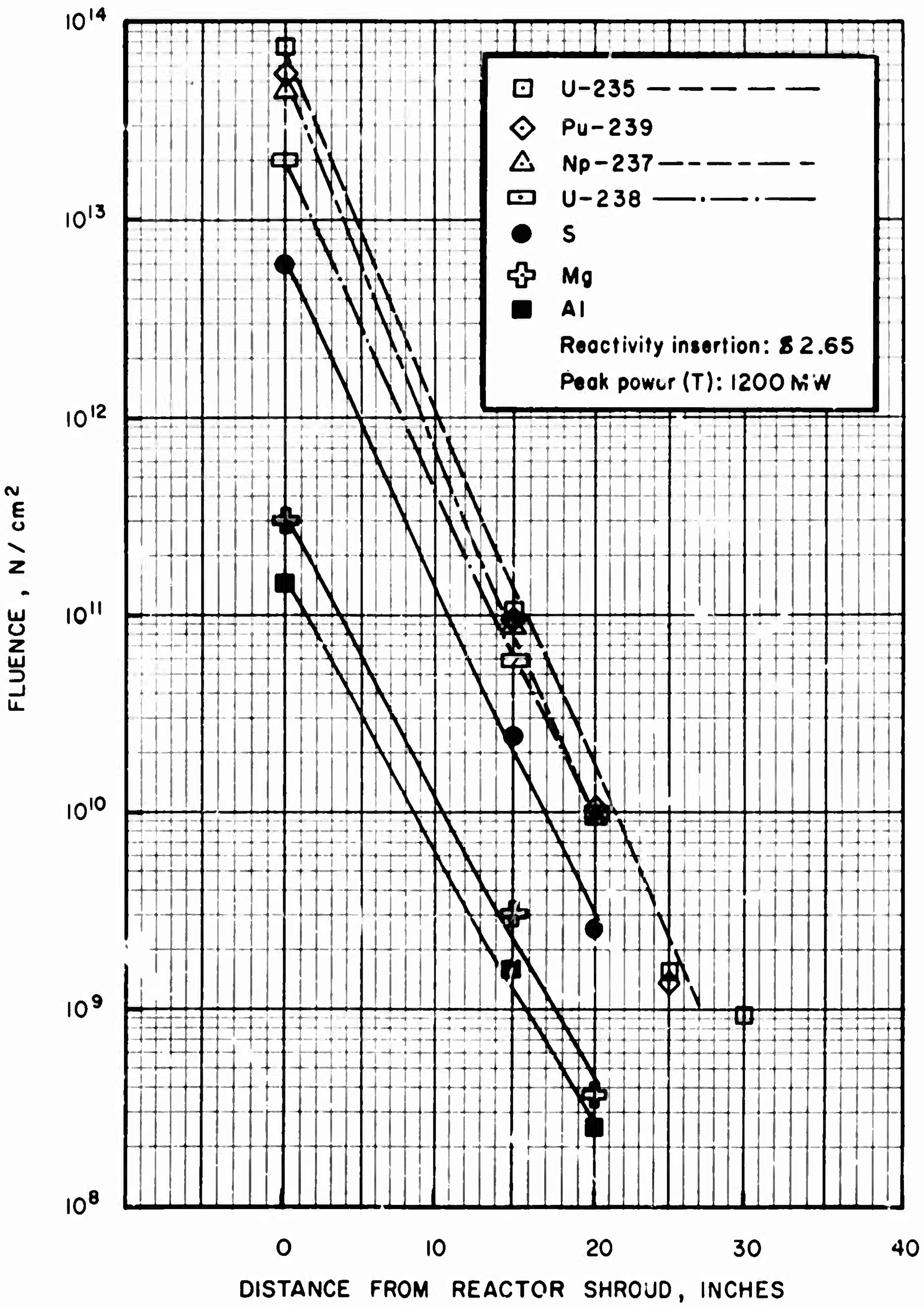


FIGURE 18. POOL RADIAL FAST NEUTRON GRADIENT, 15° FROM POOL MIDLINE, (SEE FIGURE 8), 29 INCHES ABOVE POOL FLOOR.

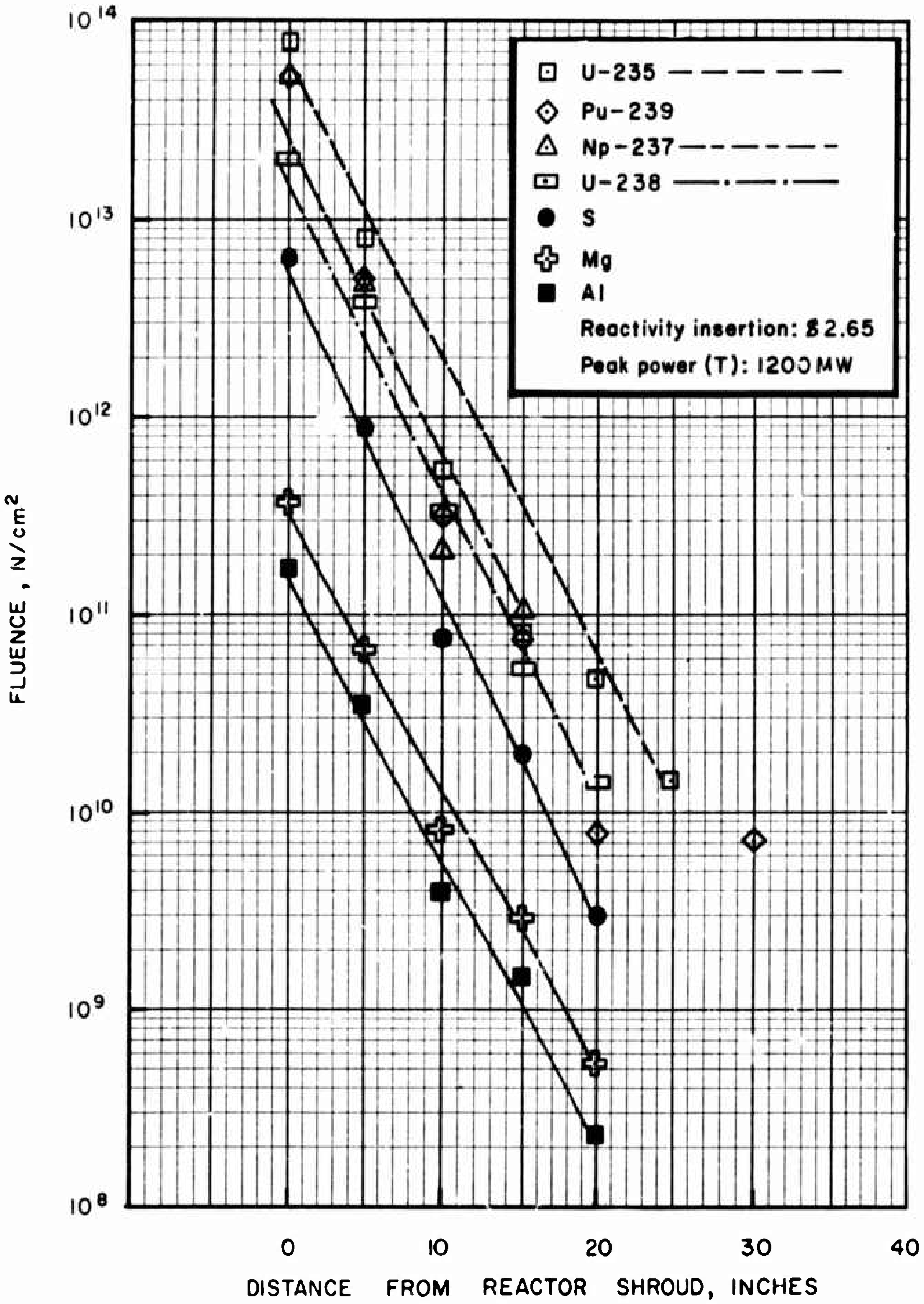


FIGURE 19. POOL RADIAL FAST NEUTRON GRADIENT, AT MIDLINE OF POOL (SEE FIGURE 8), 29 INCHES ABOVE POOL FLOOR.

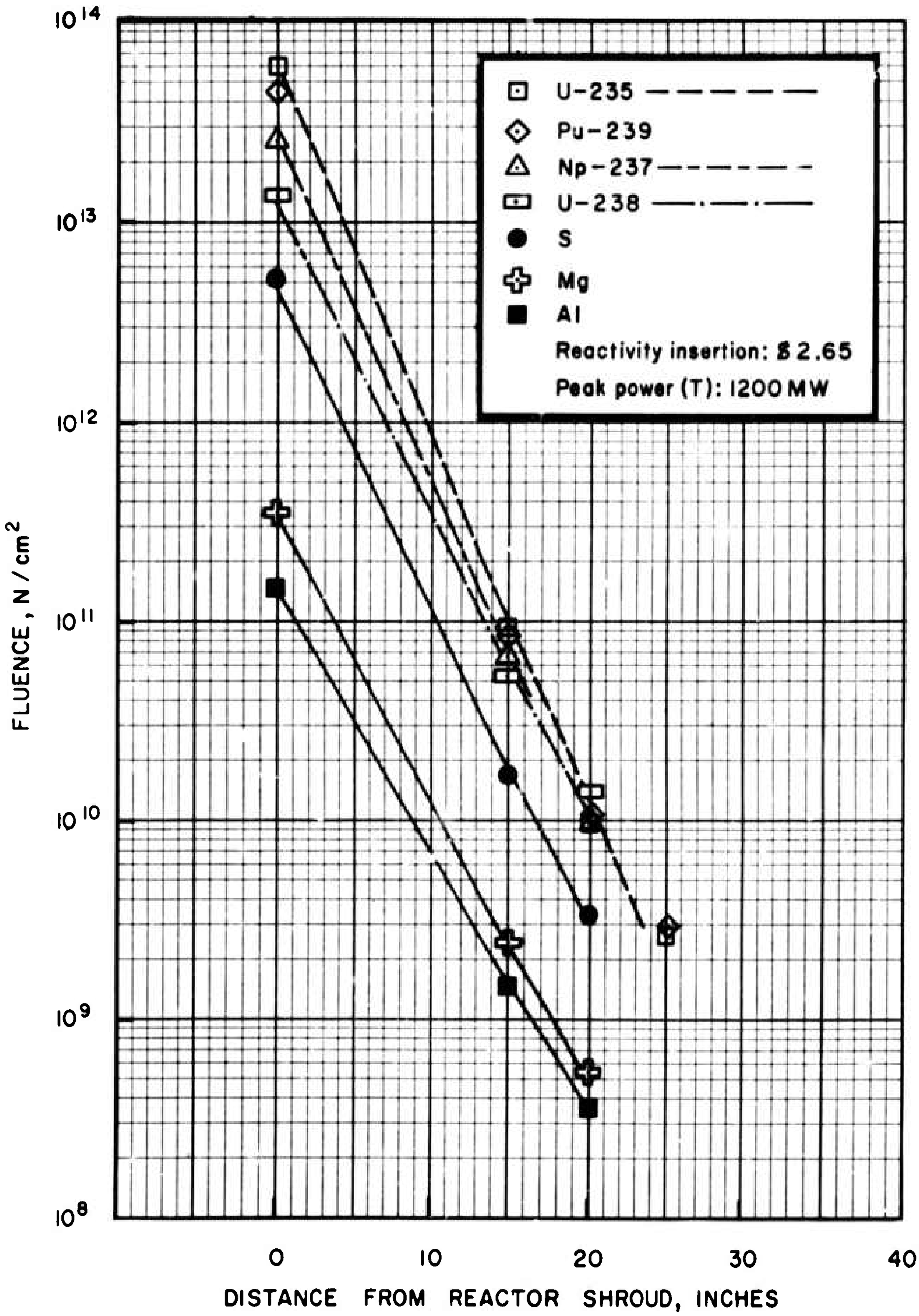


FIGURE 20. POOL RADIAL FAST NEUTRON GRADIENT, −15° FROM POOL MIDLINE, (SEE FIGURE 8), 29 INCHES ABOVE POOL FLOOR.

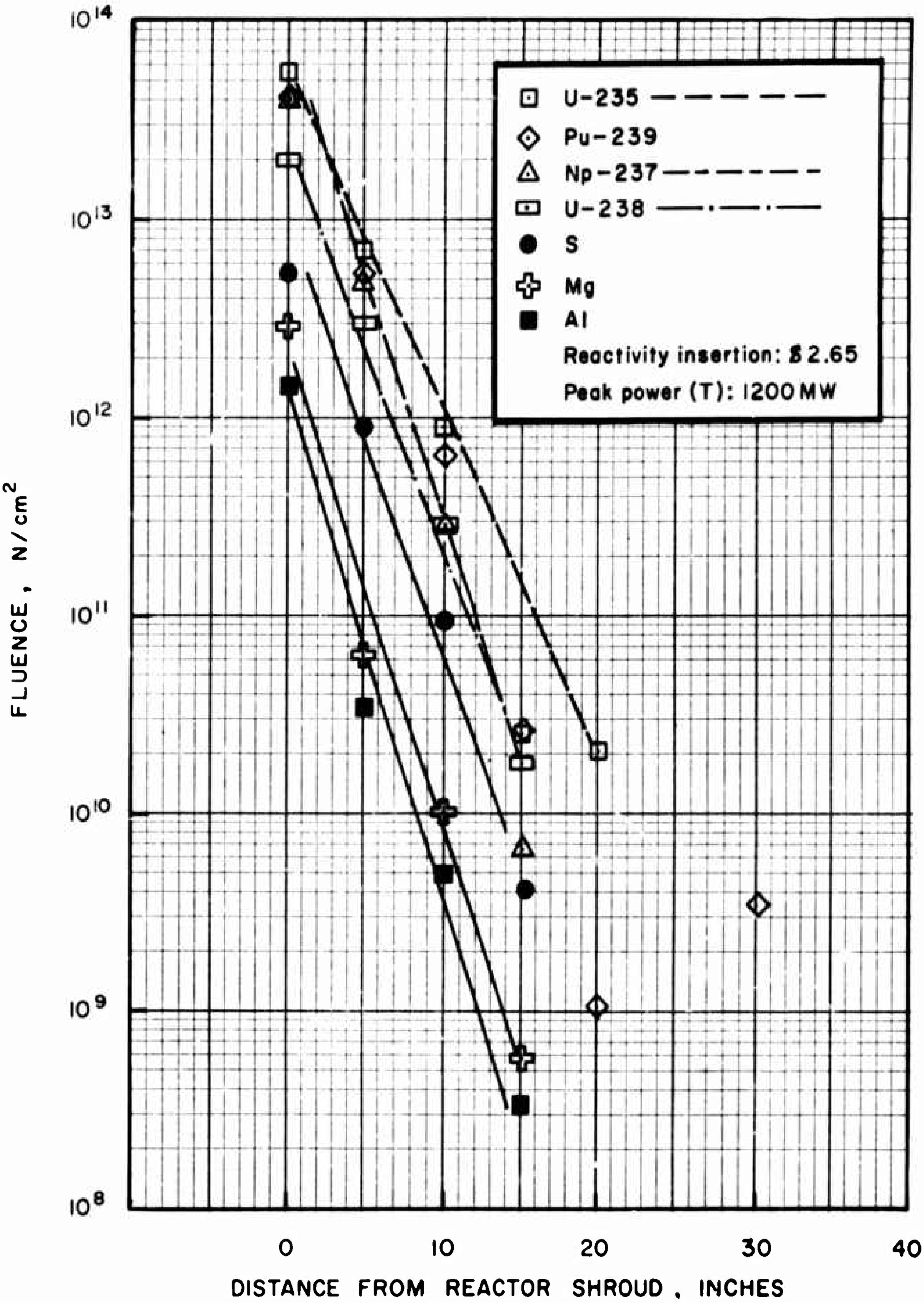


FIGURE 21. POOL RADIAL FAST NEUTRON GRADIENT -30° FROM POOL MIDLINE, (SEE FIGURE 8), 29 INCHES ABOVE POOL FLOOR.

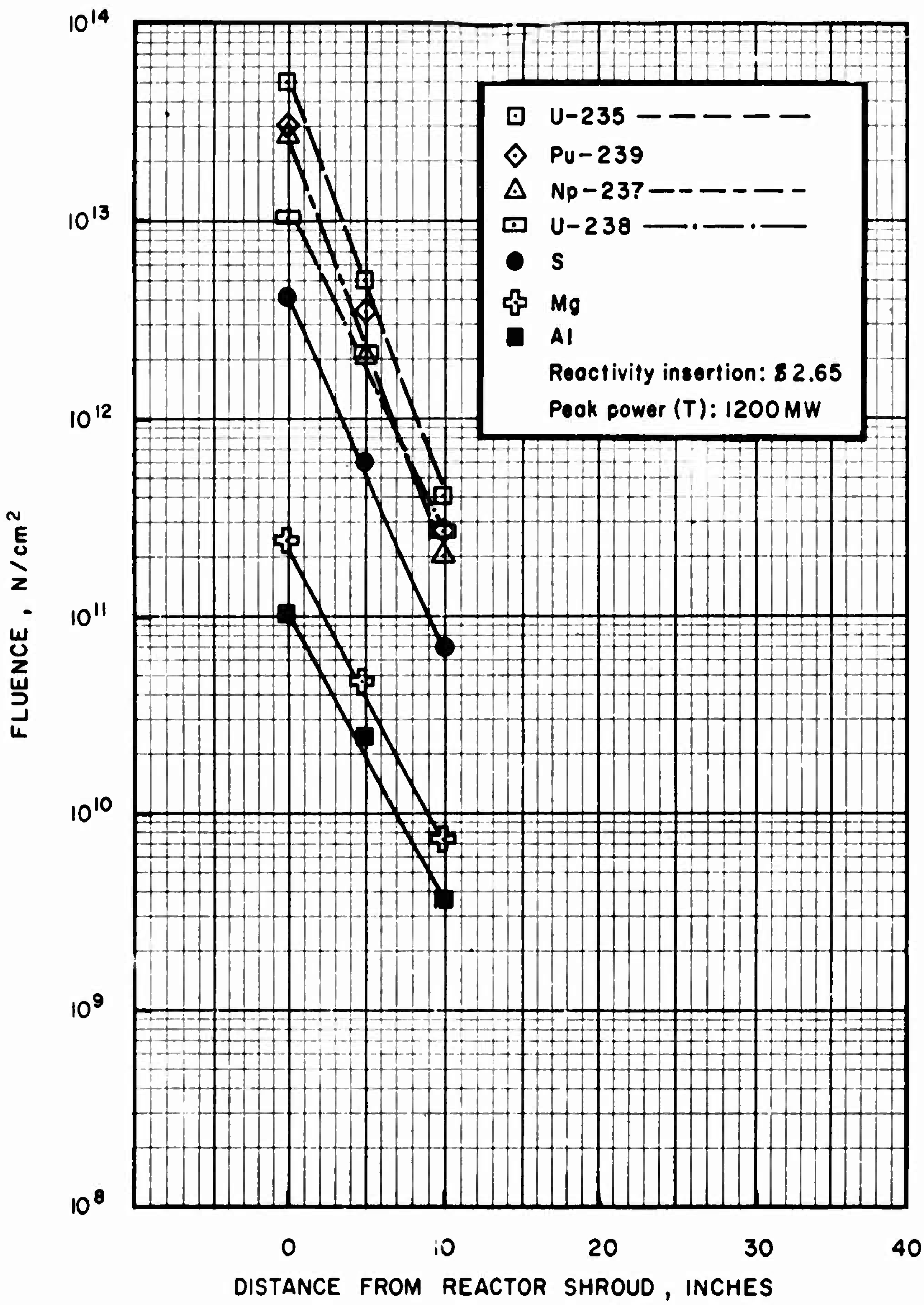


FIGURE 22. POOL RADIAL FAST NEUTRON GRADIENT, −60° FROM POOL MIDLINE, (SEE FIGURE 8), 29 INCHES ABOVE POOL FLOOR.

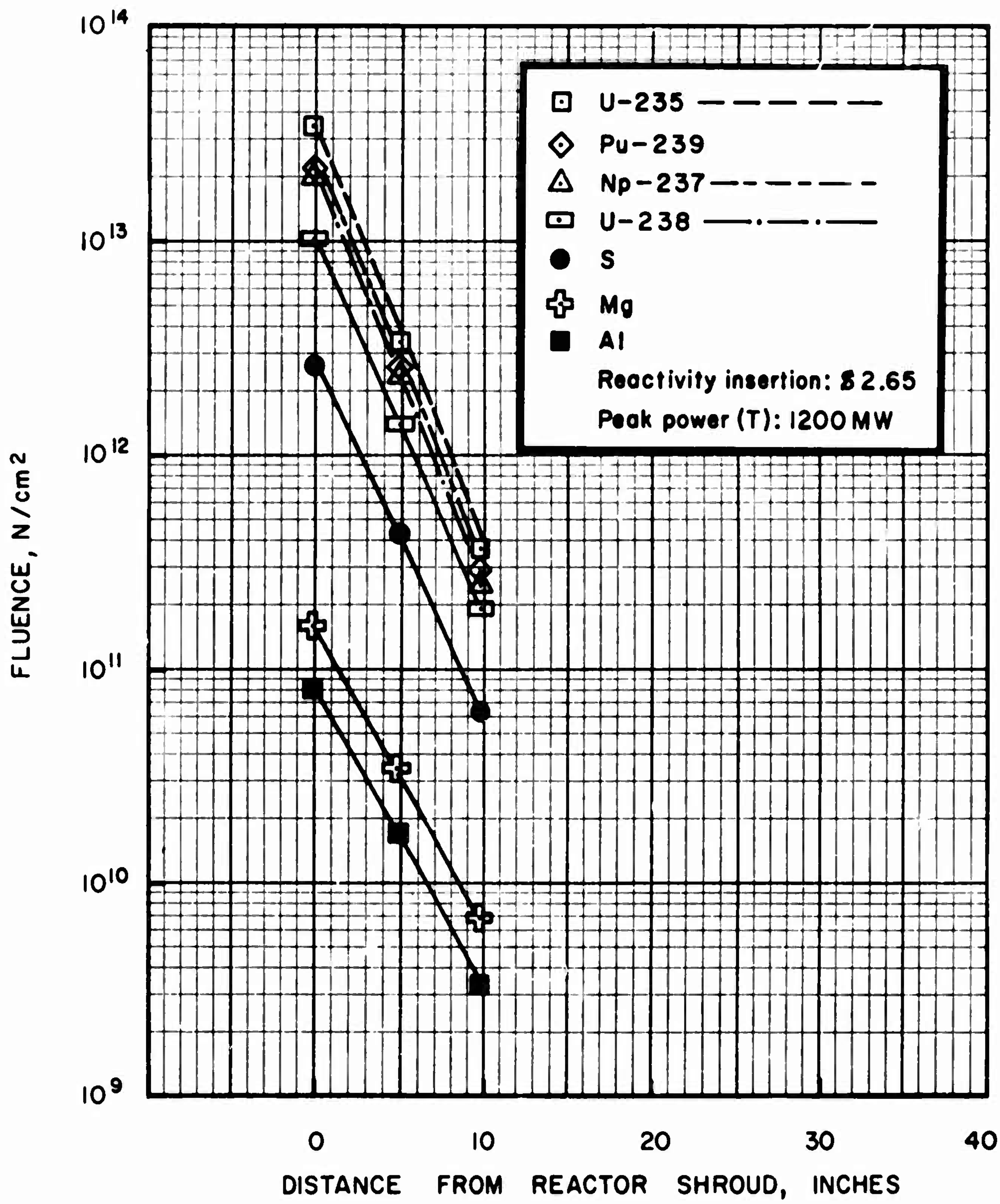


FIGURE 23. POOL RADIAL FAST NEUTRON GRADIENT, 60° FROM POOL MIDLINE (SEE FIGURE 8), 21.5 INCHES ABOVE POOL FLOOR.

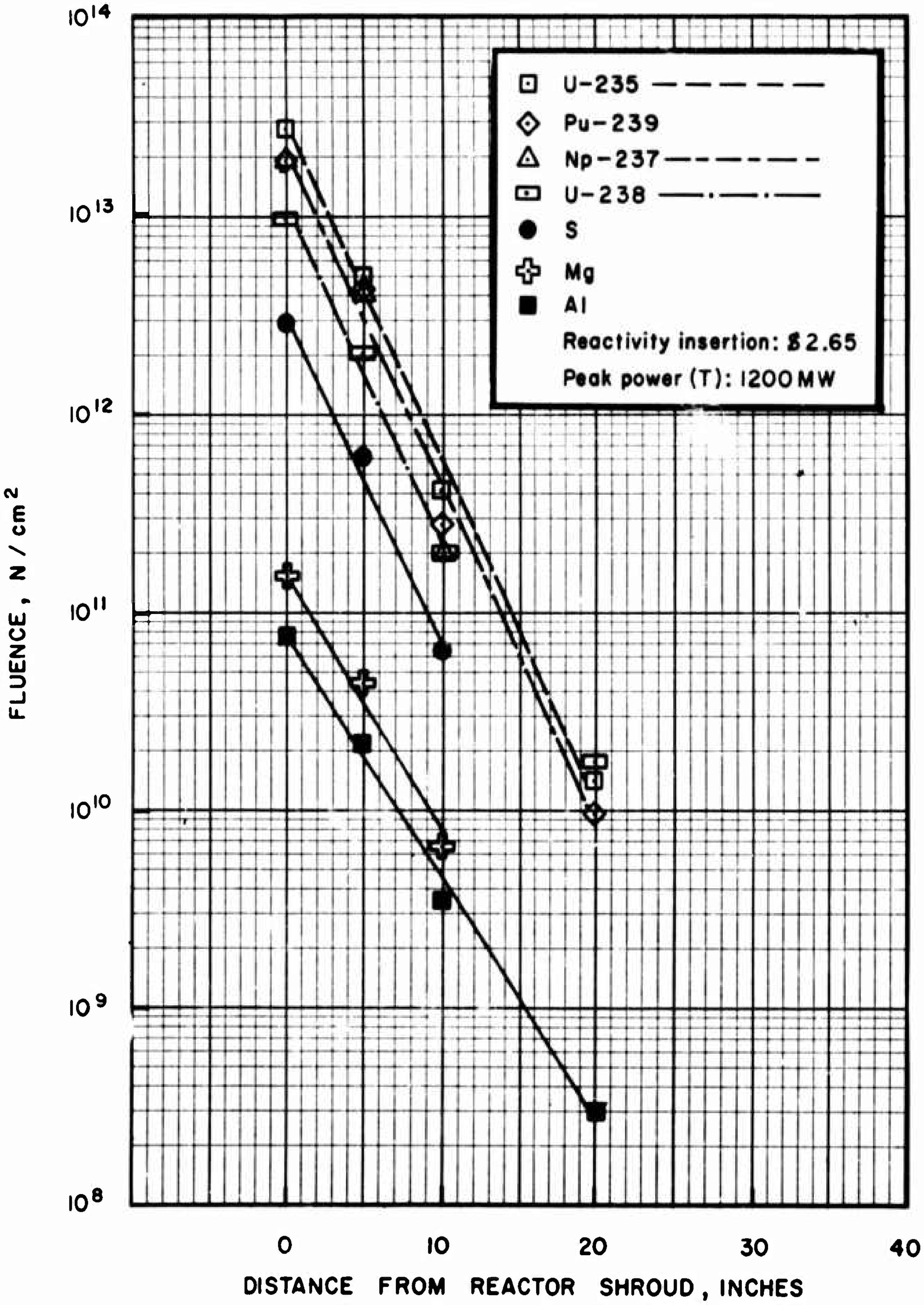


FIGURE 24. POOL RADIAL FAST NEUTRON GRADIENT, 30° FROM POOL MIDLINE, (SEE FIGURE 8), 21.5 INCHES ABOVE POOL FLOOR.

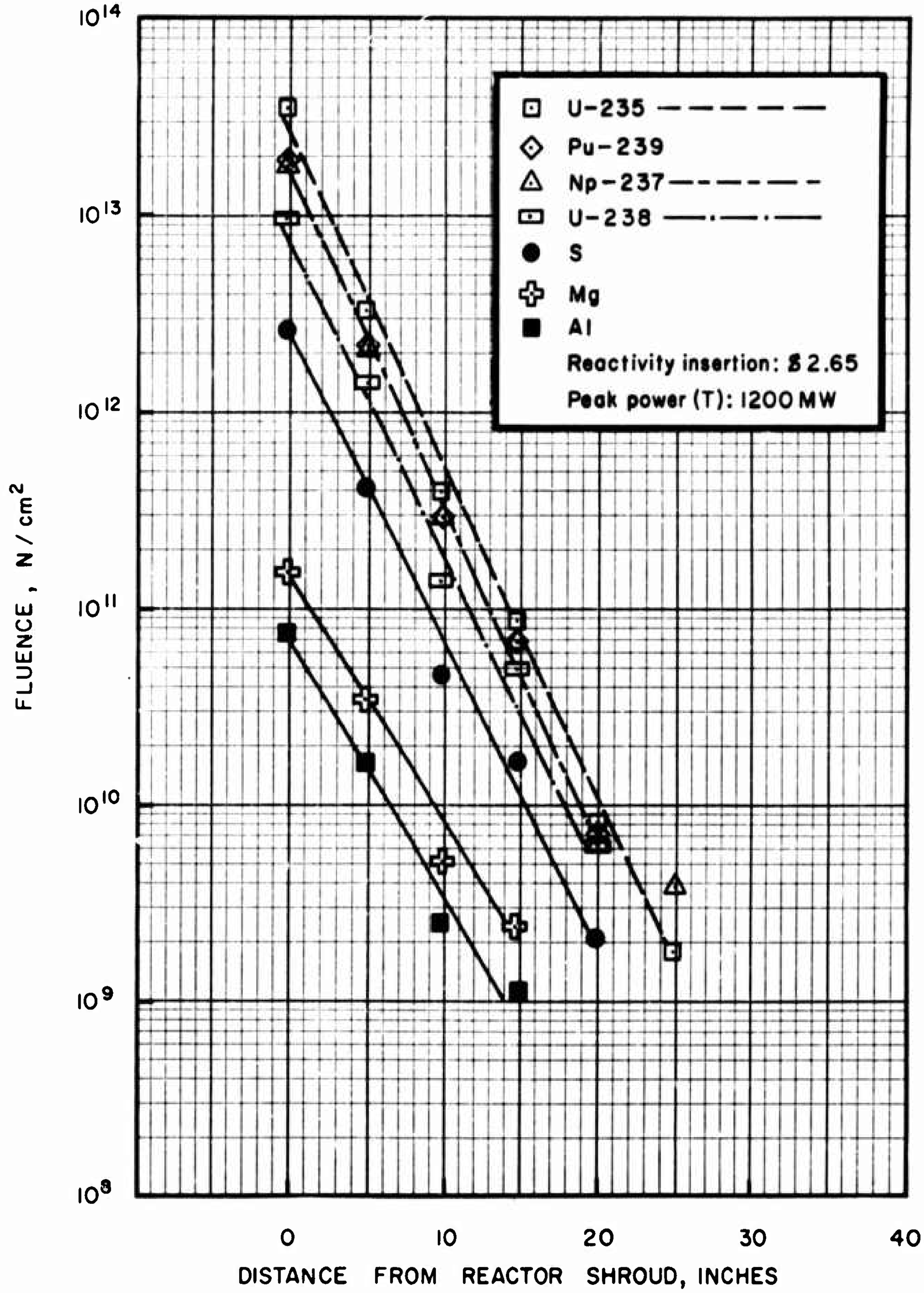


FIGURE 25. POOL RADIAL FAST NEUTRON GRADIENT, ON POOL MIDLINE (SEE FIGURE 8), 21.5 INCHES ABOVE POOL FLOOR.

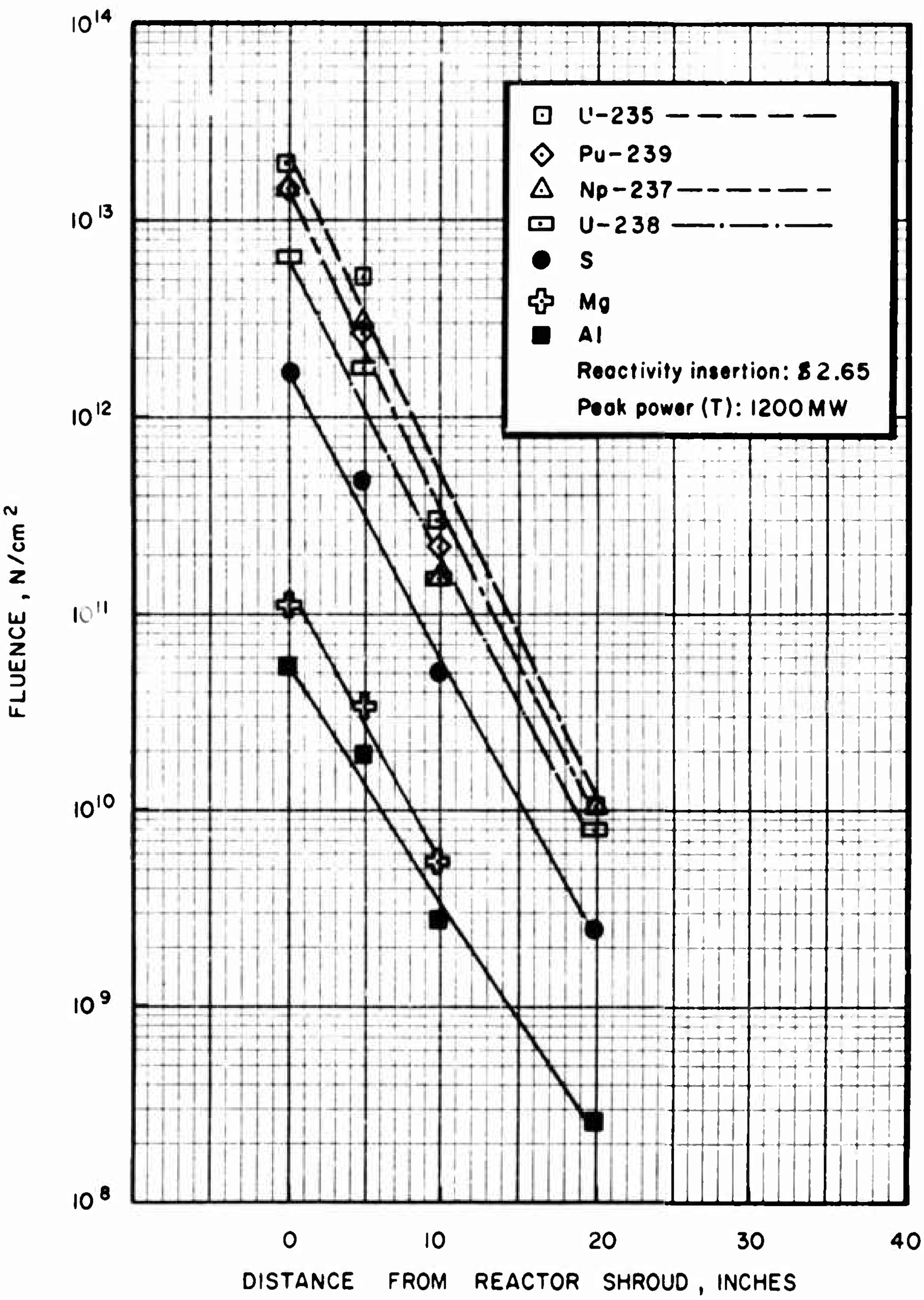


FIGURE 26. POOL RADIAL FAST NEUTRON GRADIENT, −30° FROM POOL MIDLINE, (SEE FIGURE 8), 21.5 INCHES ABOVE POOL FLOOR.

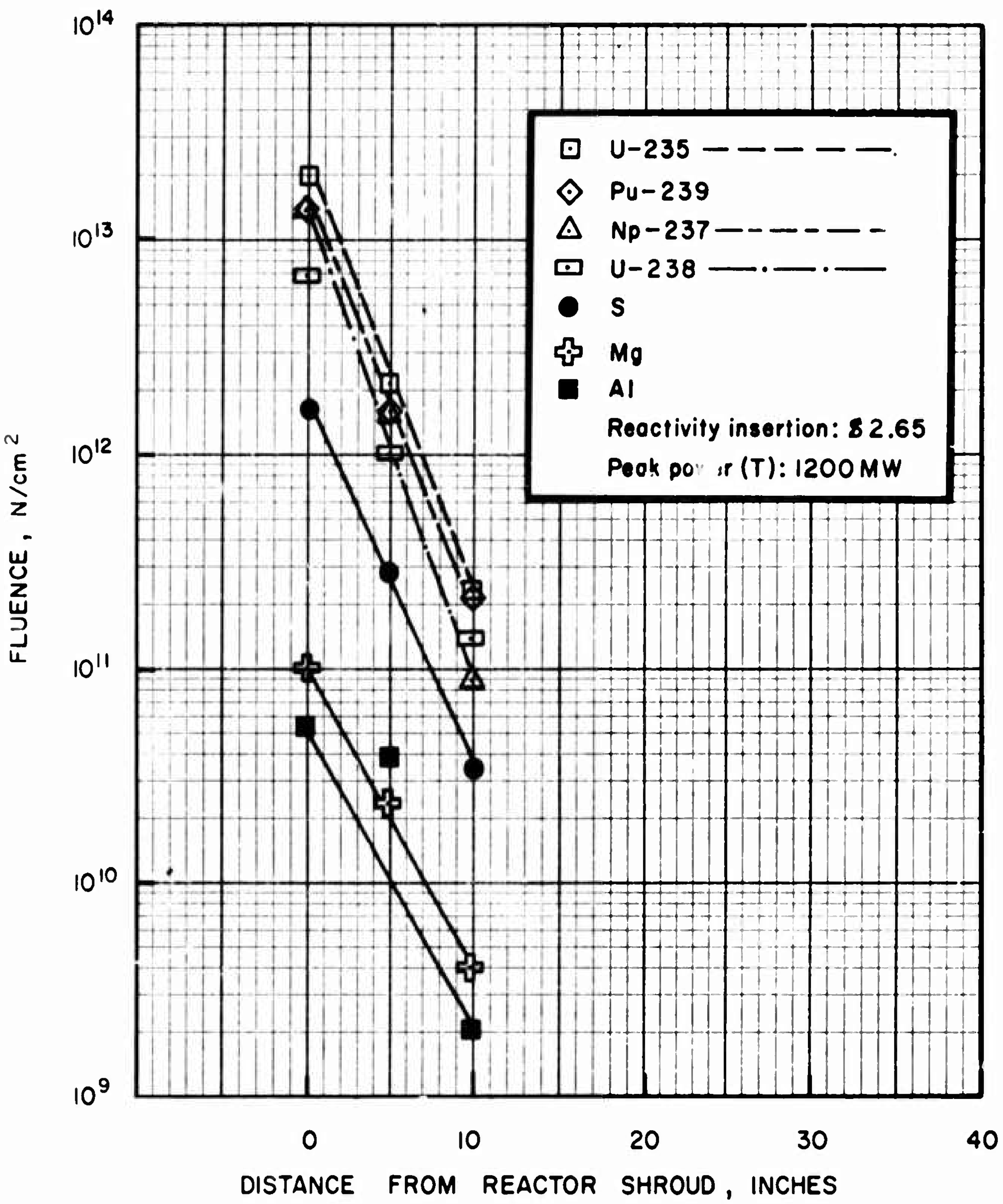


FIGURE 27. POOL RADIAL FAST NEUTRON GRADIENT, -60° FROM POOL MIDLINE, (SEE FIGURE 8), 21.5 INCHES ABOVE POOL FLOOR.

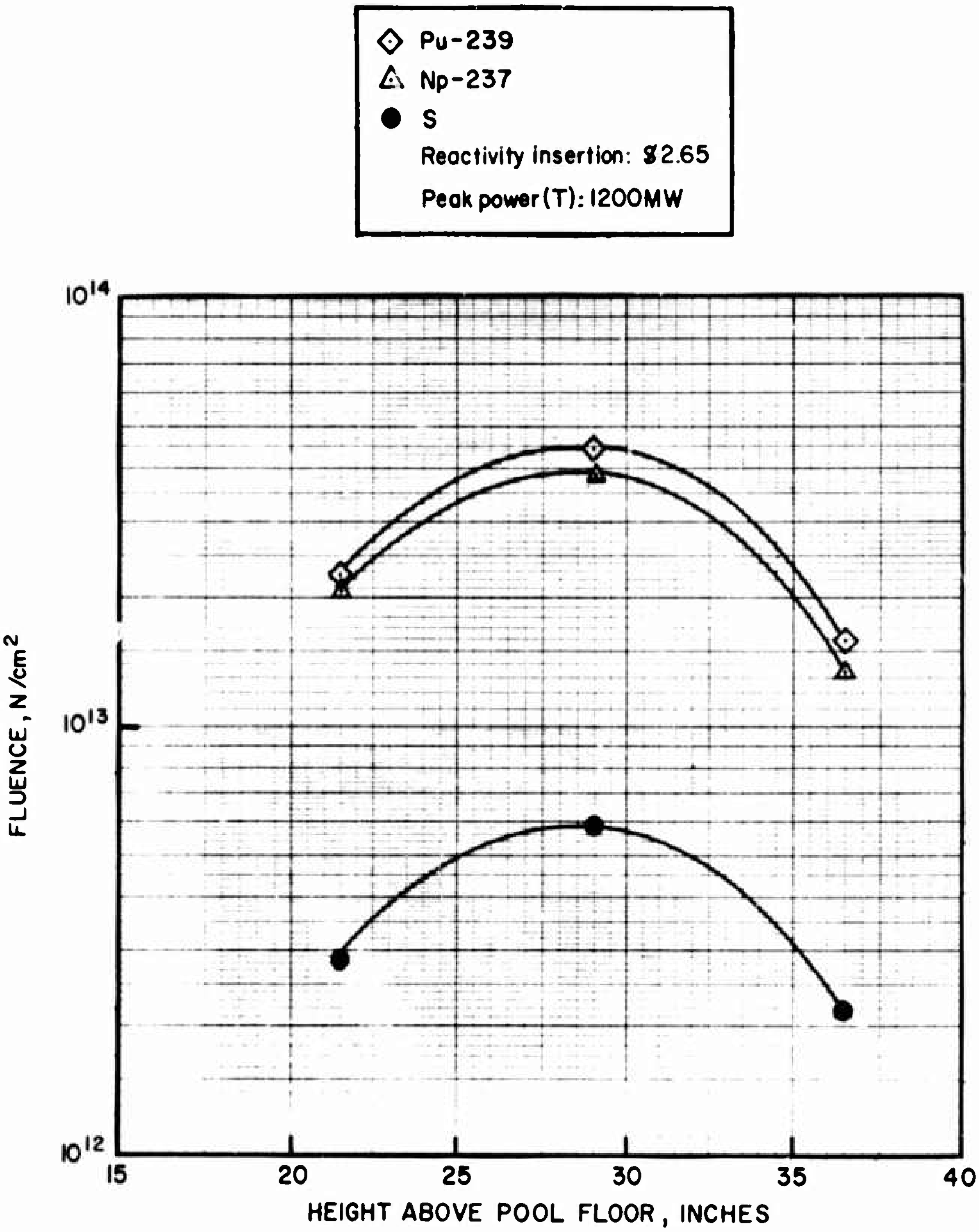


FIGURE 28. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, ADJACENT TO CORE, 60° FROM POOL MIDLINE (SEE FIGURE 8).

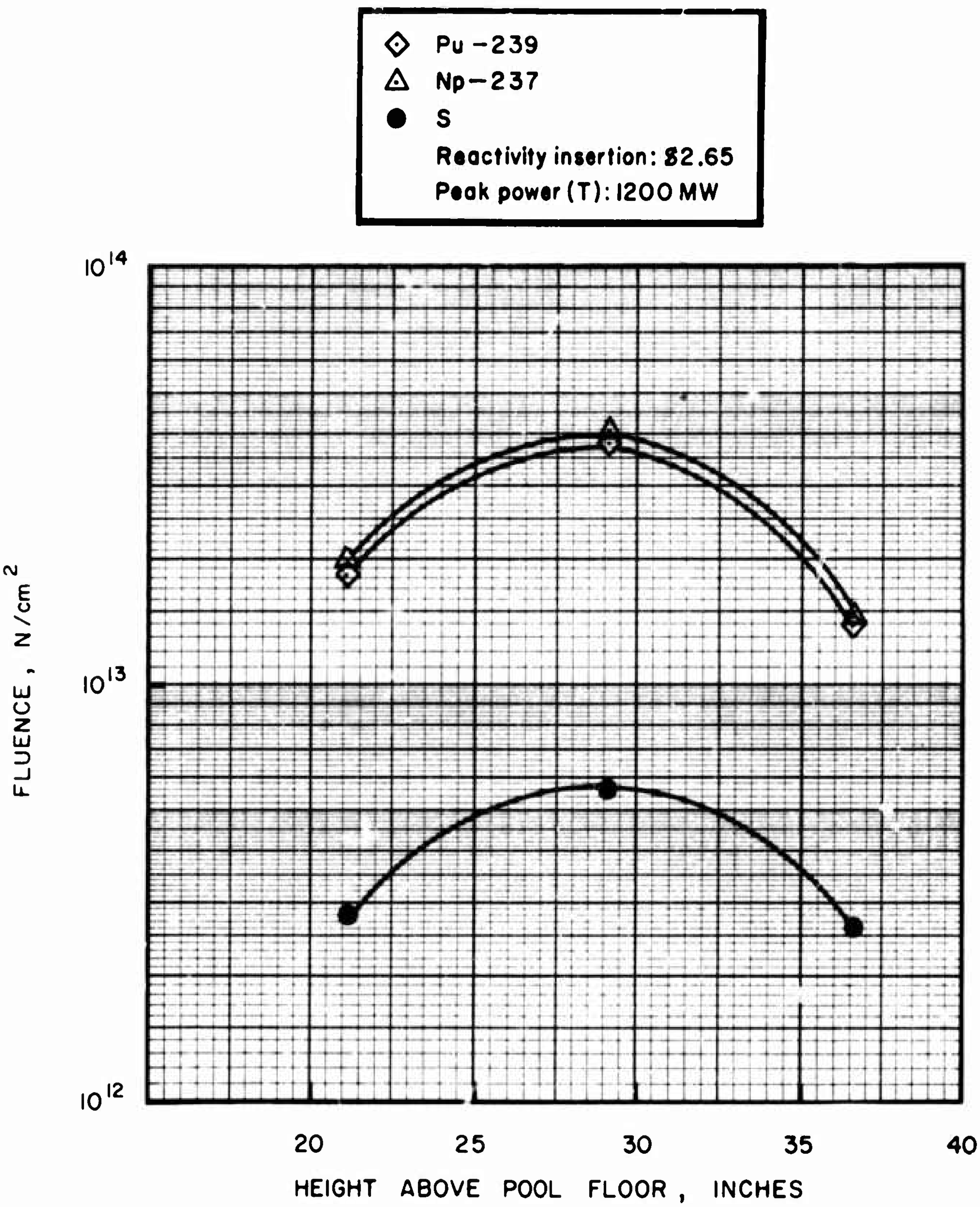


FIGURE 29. POOL VERTICAL FAST NEUTRON FIELD GRADIENT ADJACENT TO CORE, 30° FROM POOL MIDLINE (SEE FIGURE 8).

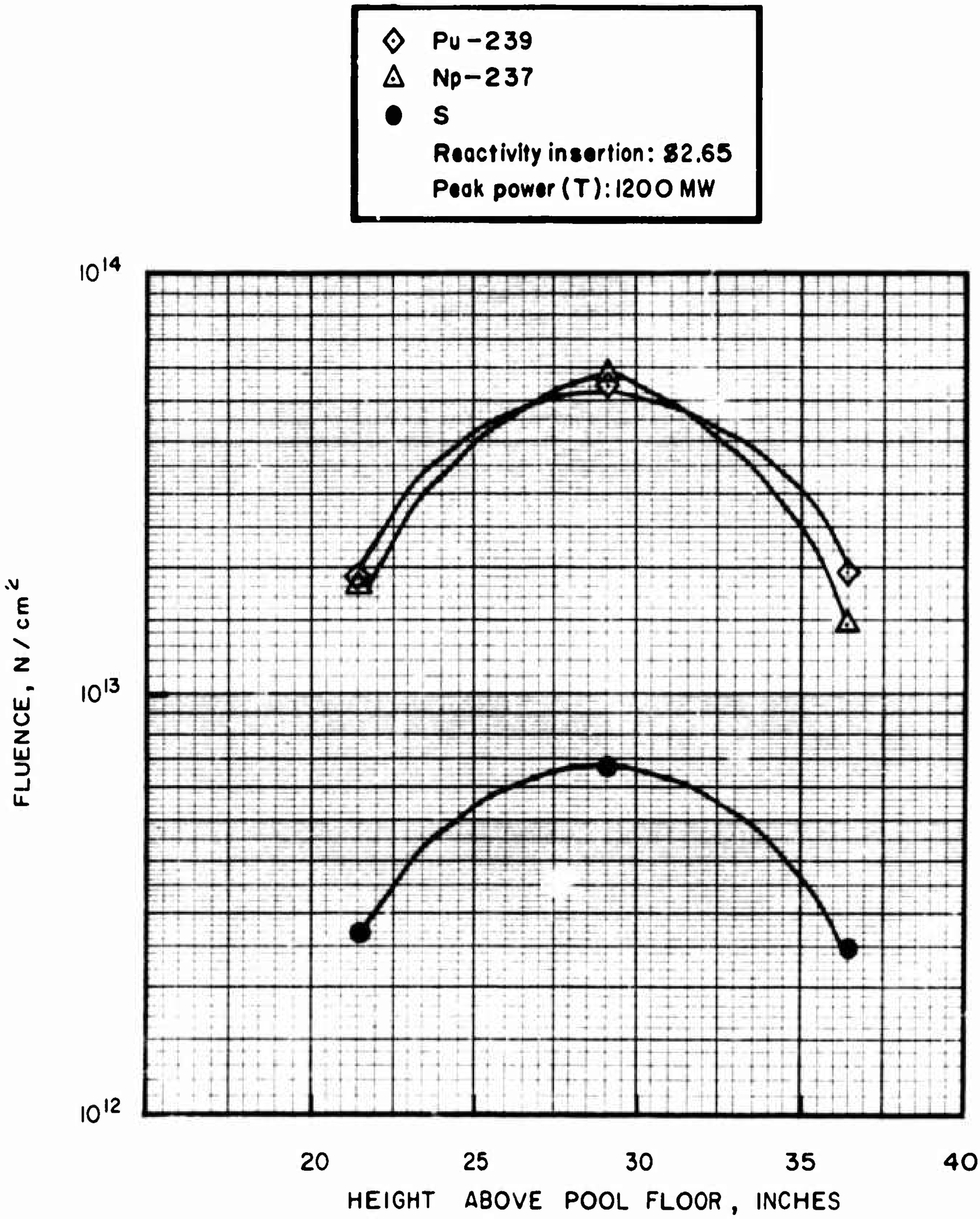


FIGURE 30. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, ADJACENT TO CORE ON POOL MIDLINE (SEE FIGURE 8).

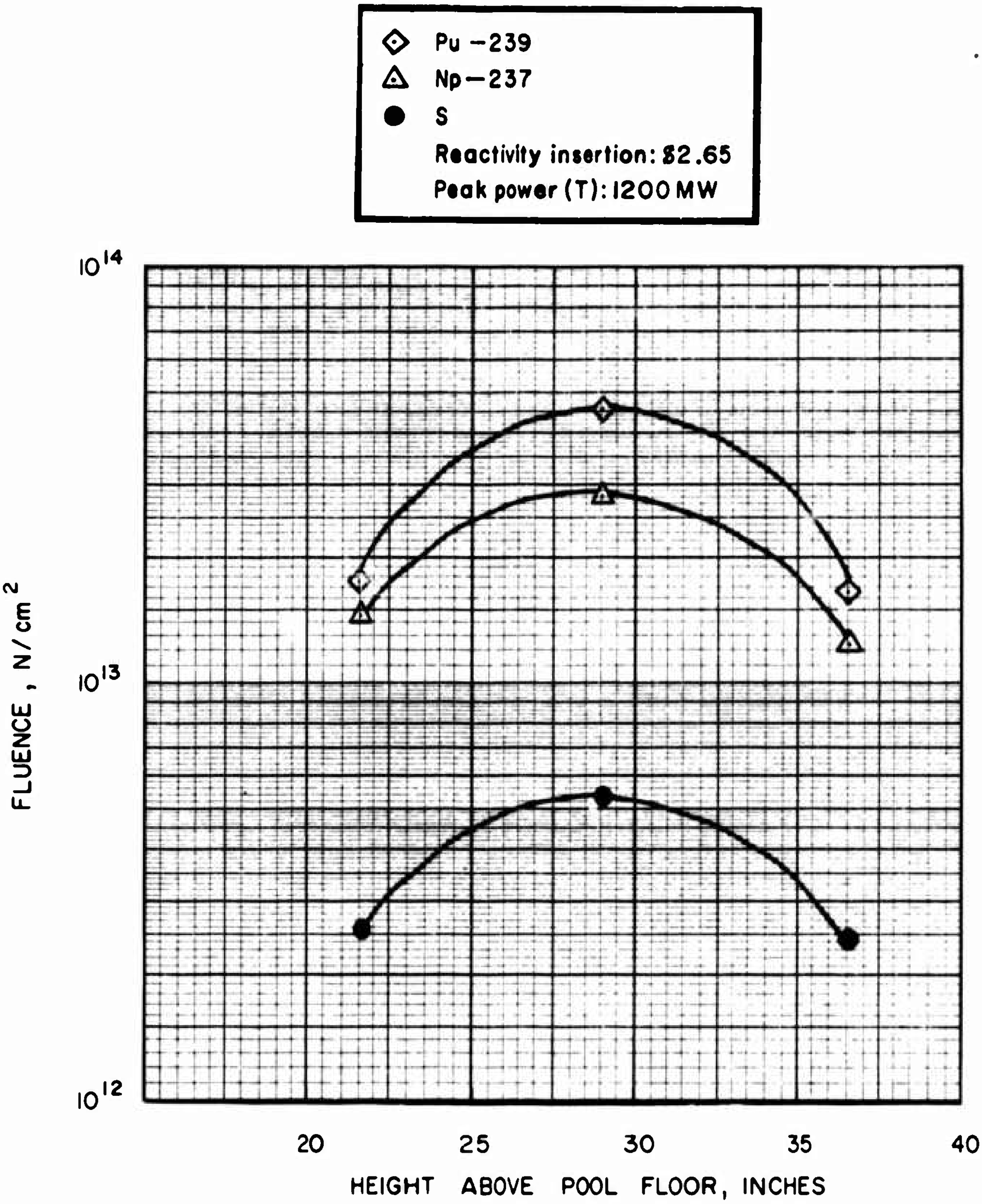


FIGURE 31. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, ADJACENT TO CORE, —15° FROM POOL MIDLINE (SEE FIGURE 8).

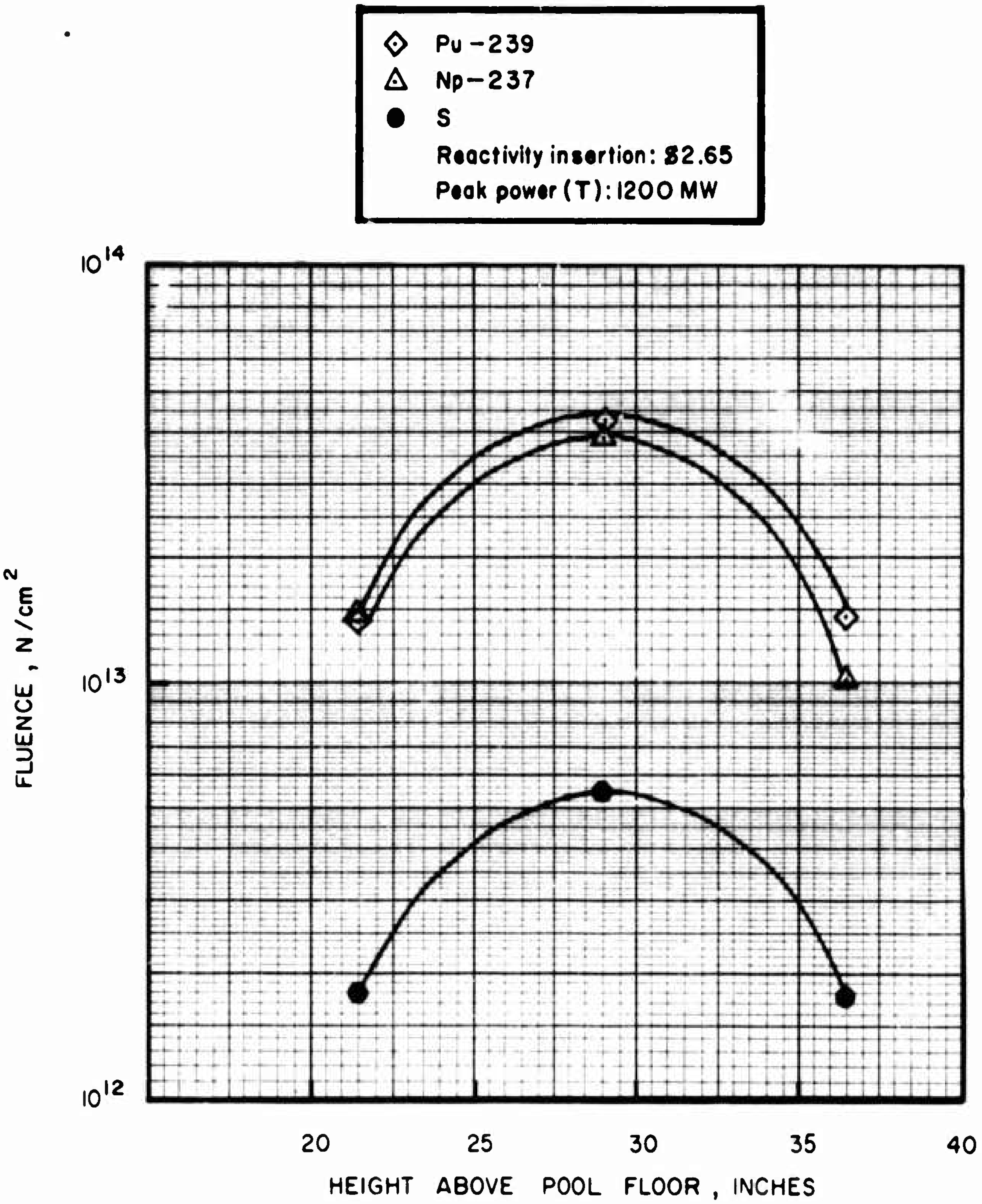


FIGURE 32. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, ADJACENT TO CORE, −30° FROM POOL MIDLINE (SEE FIGURE 8).

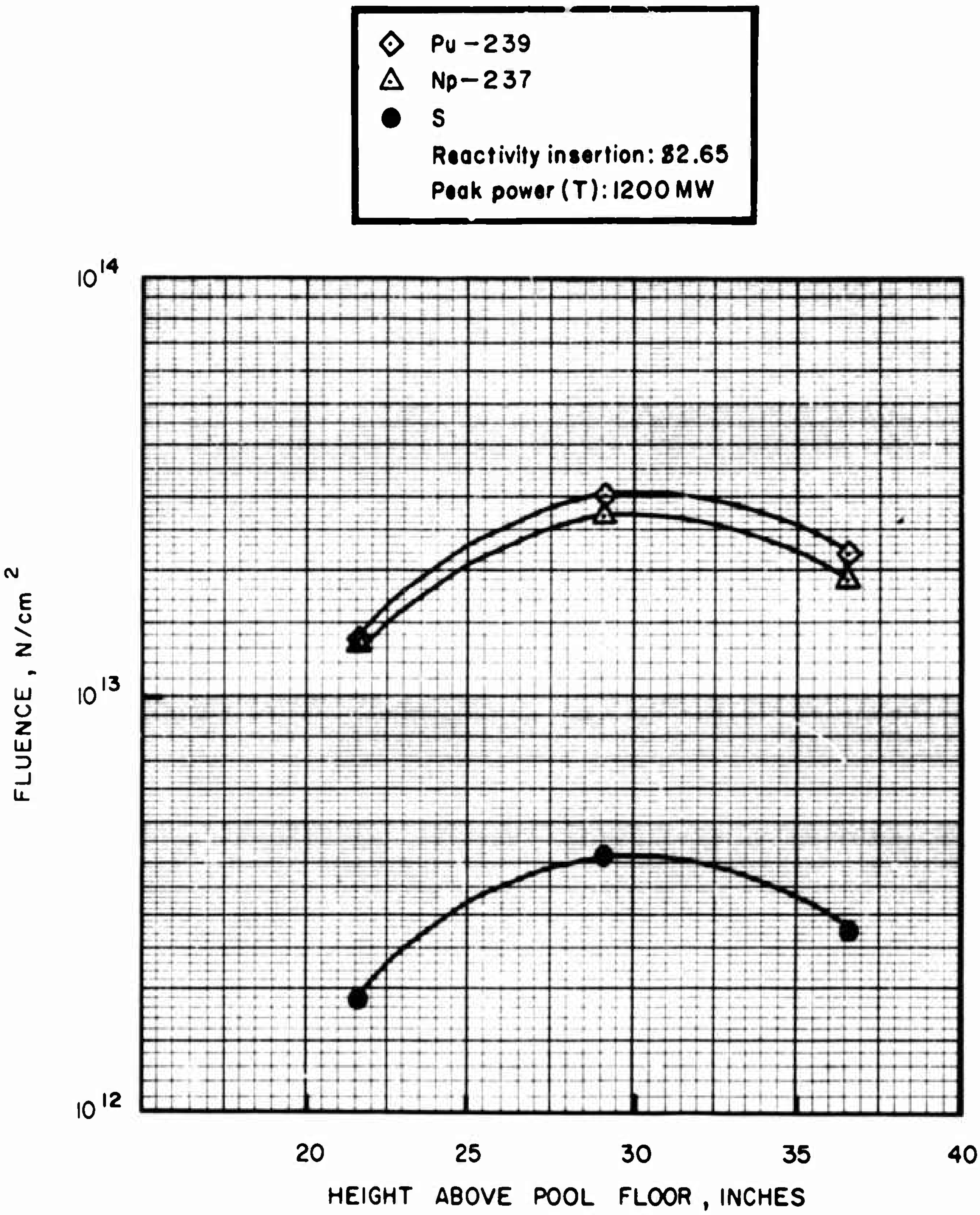


FIGURE 33. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, ADJACENT TO CORE, −60° FROM POOL MIDLINE (SEE FIGURE 8).

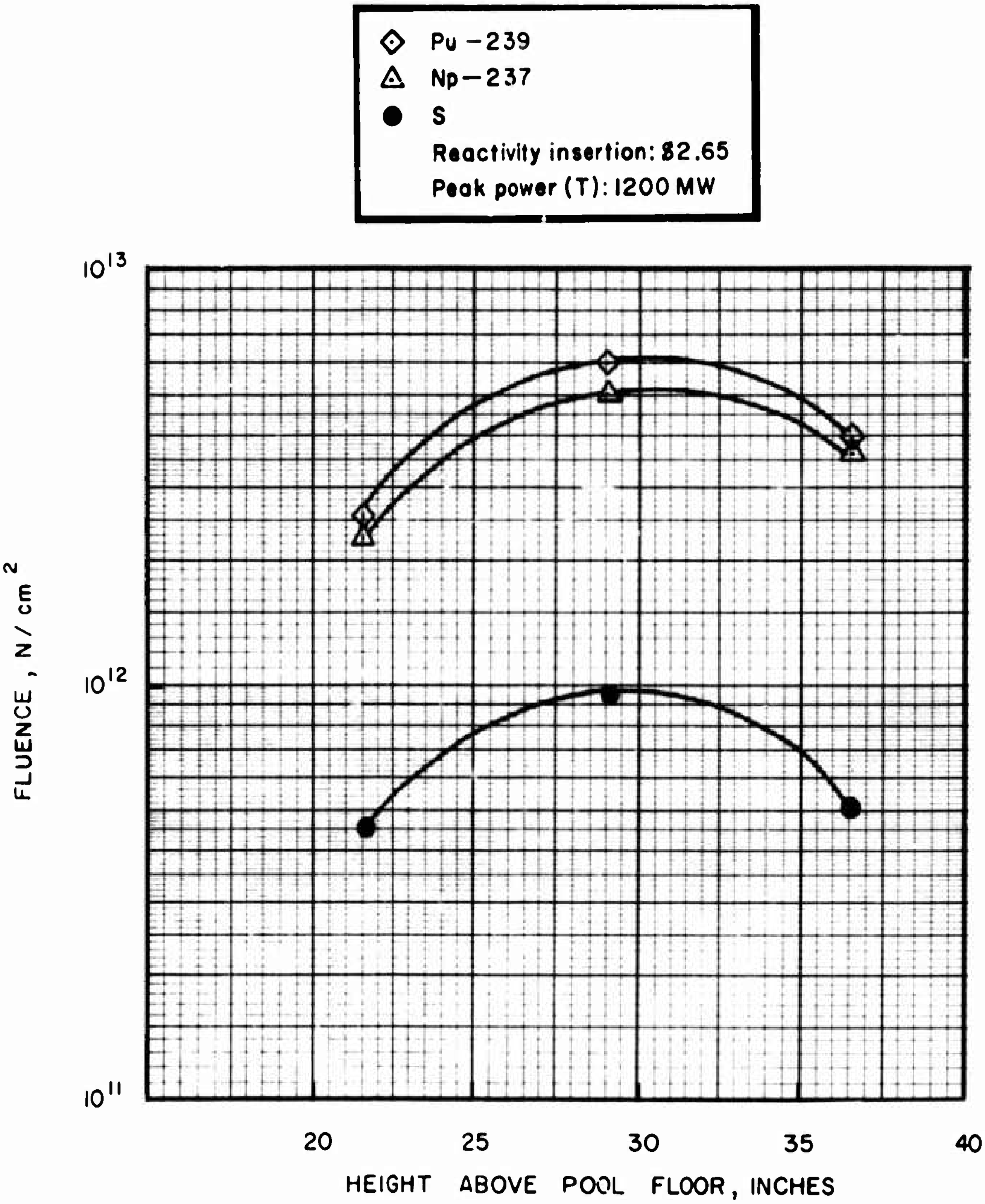


FIGURE 34. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, 5 INCHES FROM CORE, 60° FROM POOL MIDLINE (SEE FIGURE 8).

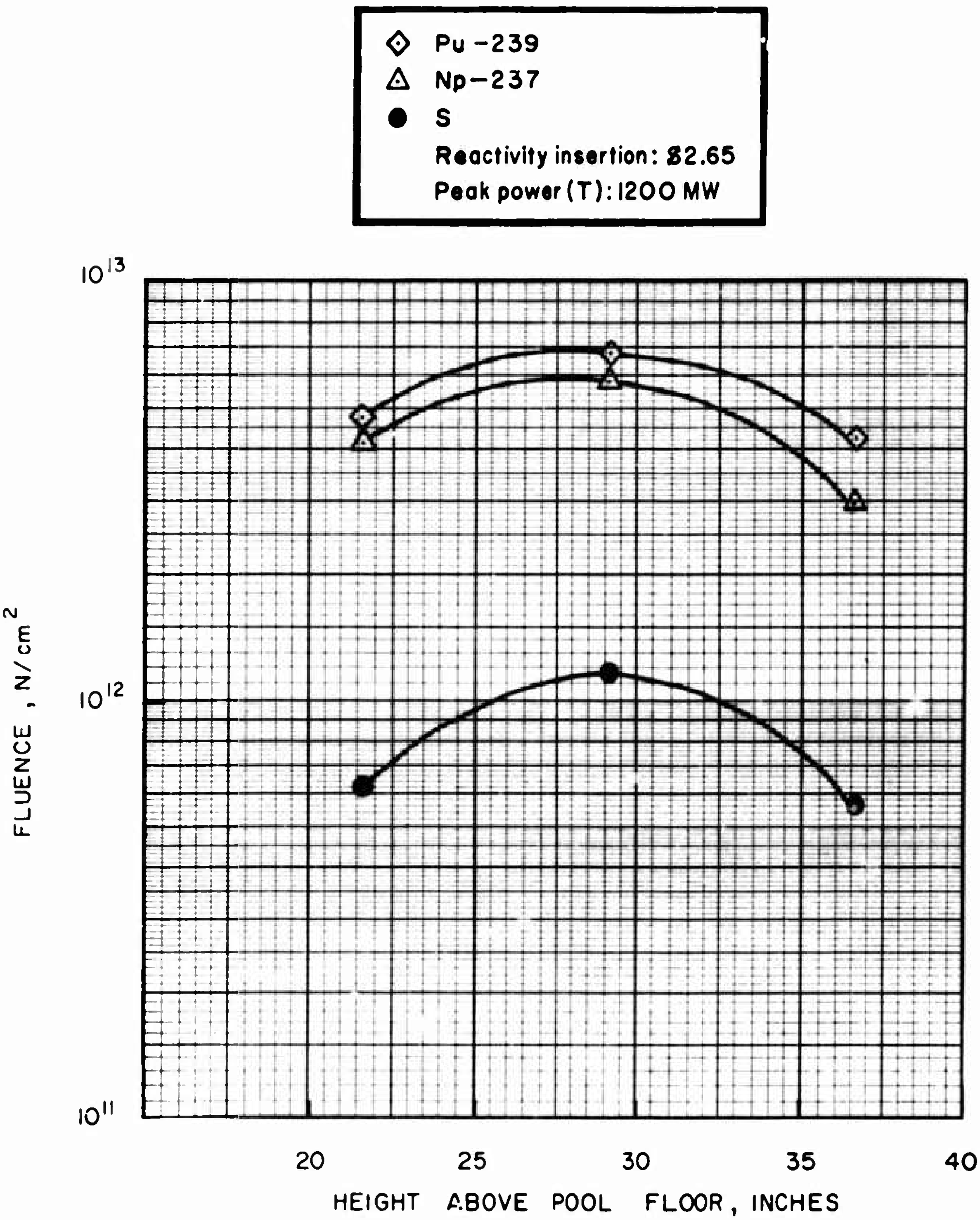


FIGURE 35. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, 5 INCHES FROM CORE, 30° FROM POOL MIDLINE (SEE FIGURE 8).

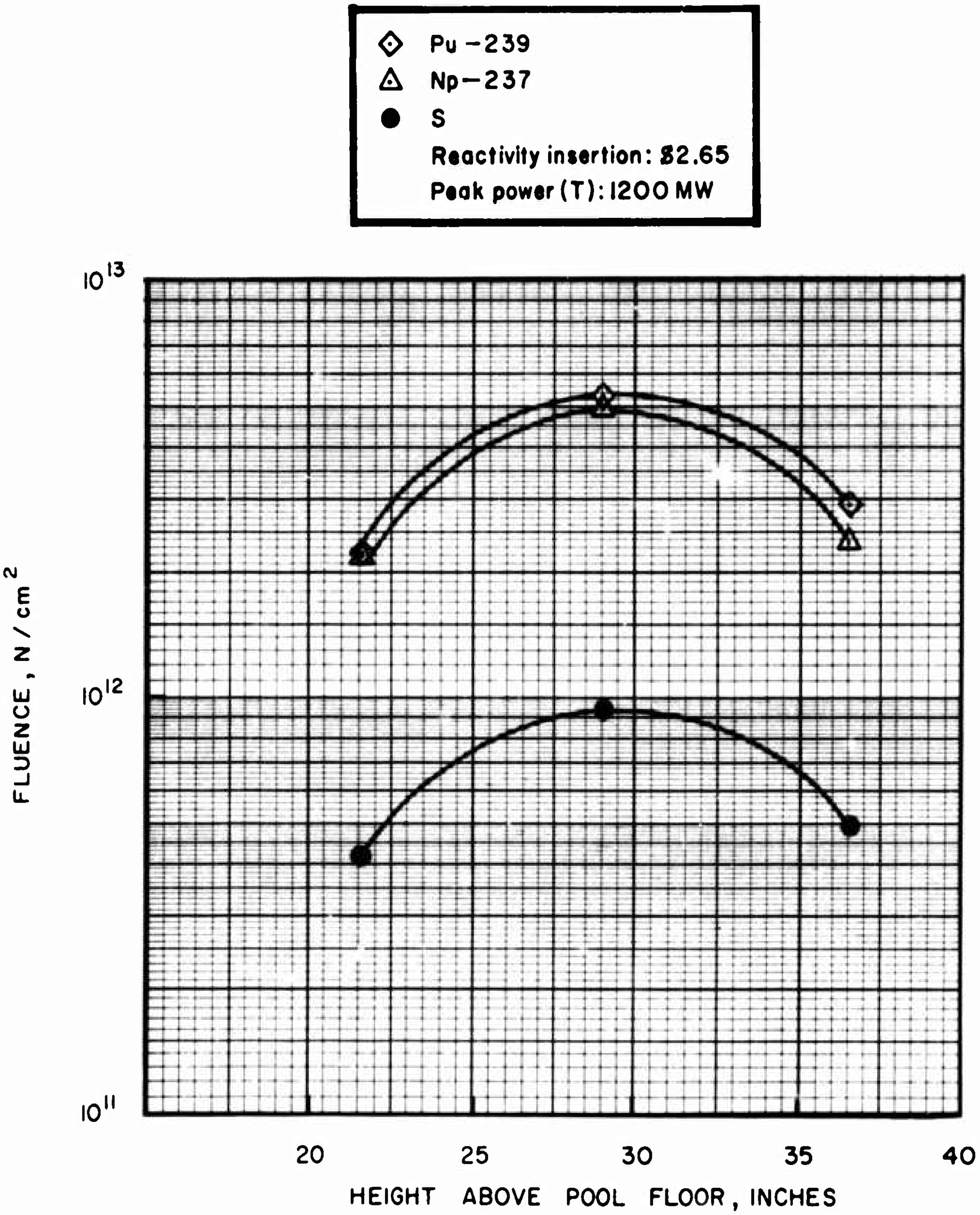


FIGURE 36. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, 5 INCHES FROM CORE, ON POOL MIDLINE (SEE FIGURE 8).

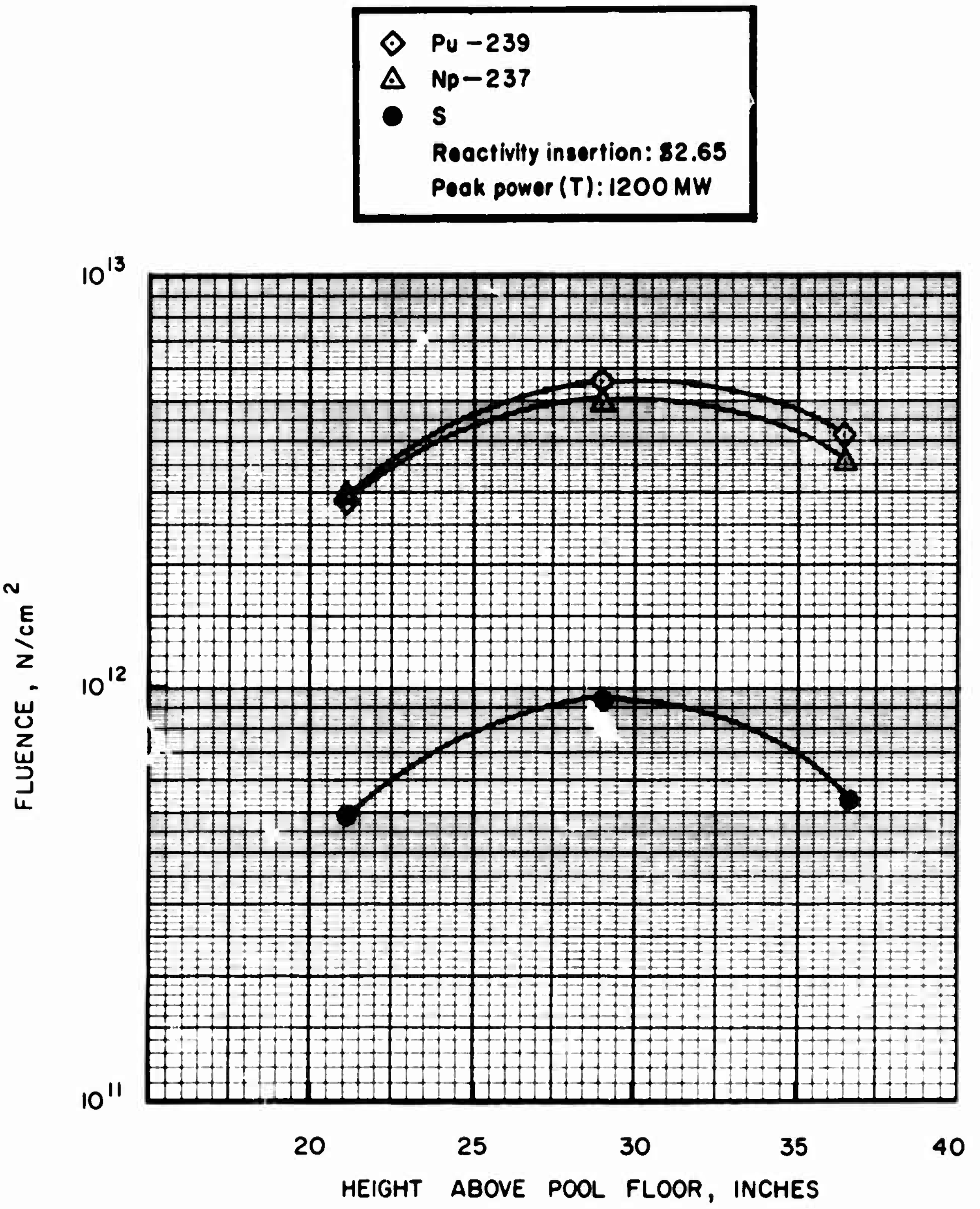


FIGURE 37. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, 5 INCHES FROM CORE, −30° FROM POOL MIDLINE (SEE FIGURE 8).

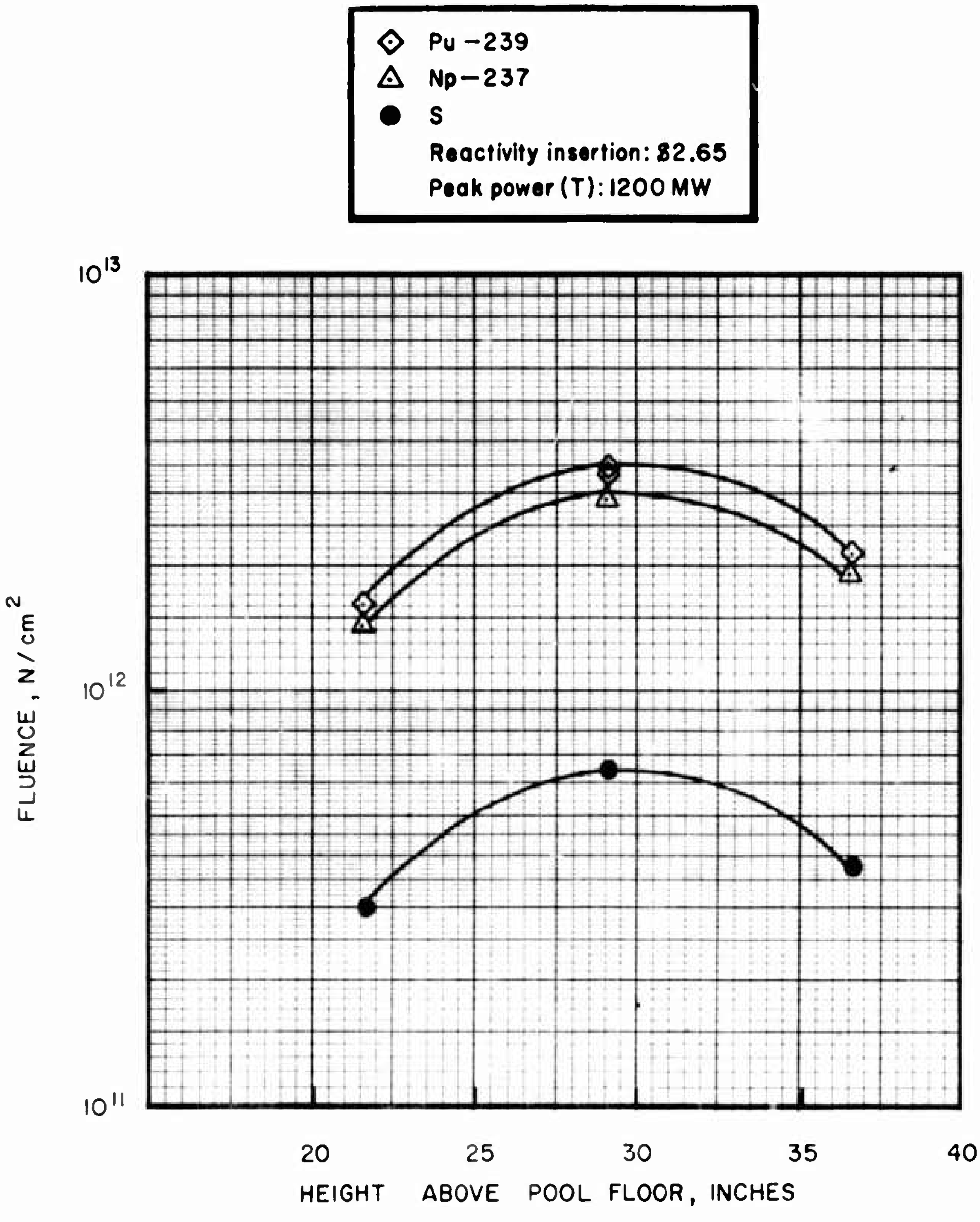


FIGURE 38, POOL VERTICAL FAST NEUTRON FIELD GRADIENT, 5 INCHES FROM CORE, -60° FROM POOL MIDLINE (SEE FIGURE 8).

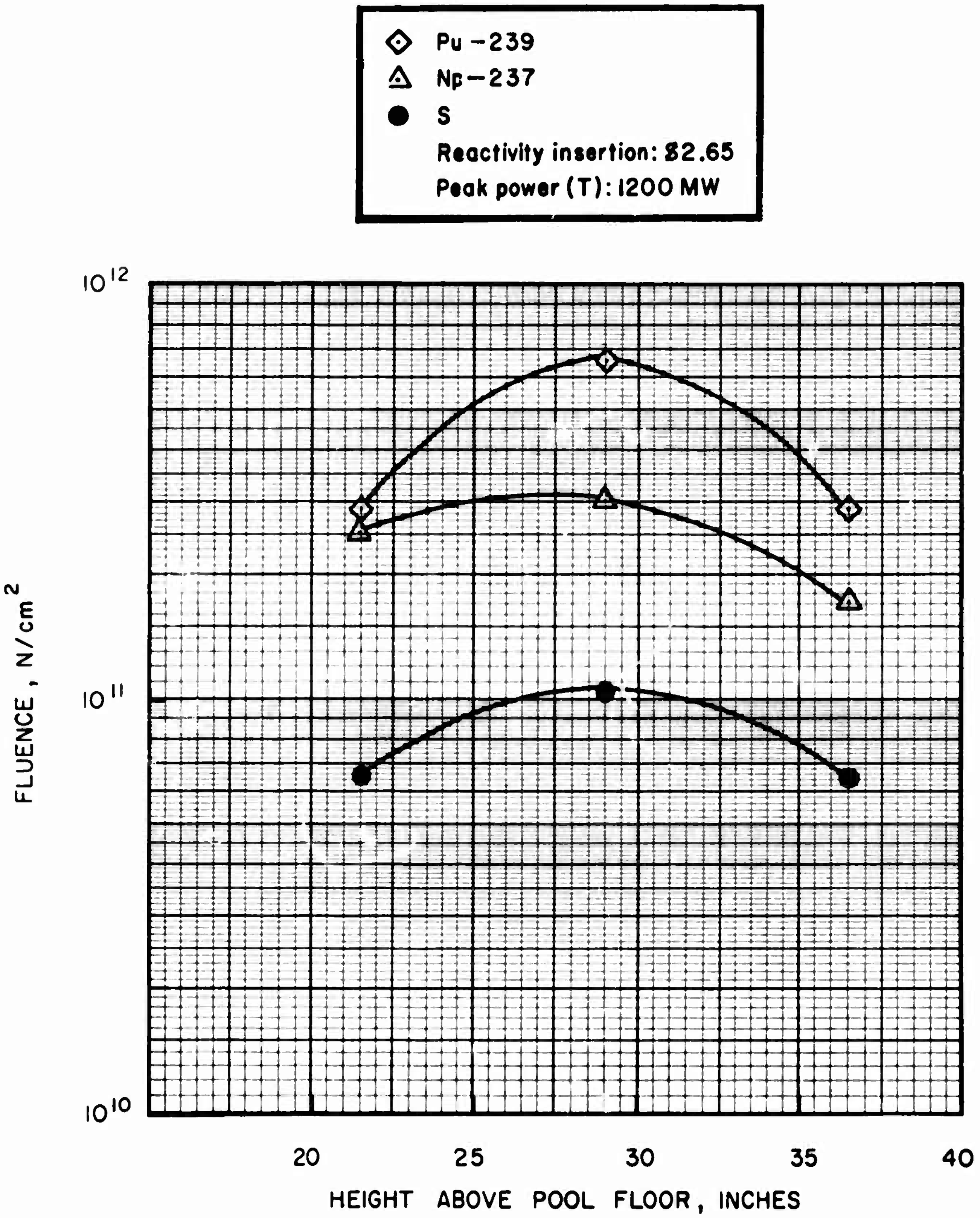


FIGURE 39. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, 10 INCHES FROM CORE, 60° FROM POOL MIDLINE (SEE FIGURE 8).

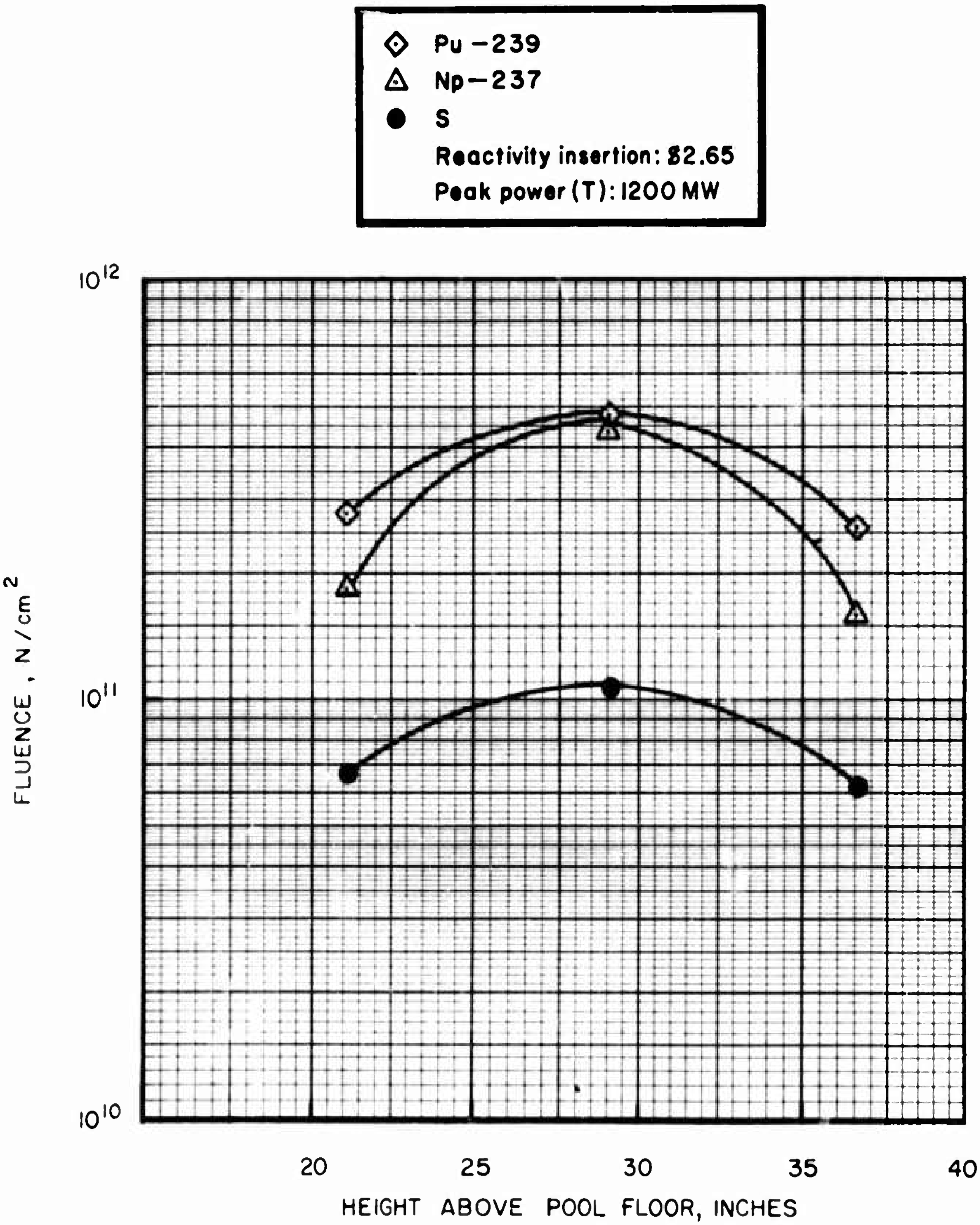


FIGURE 40. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, 10 INCHES FROM CORE EDGE, 30° FROM POOL MIDLINE (SEE FIGURE 8).

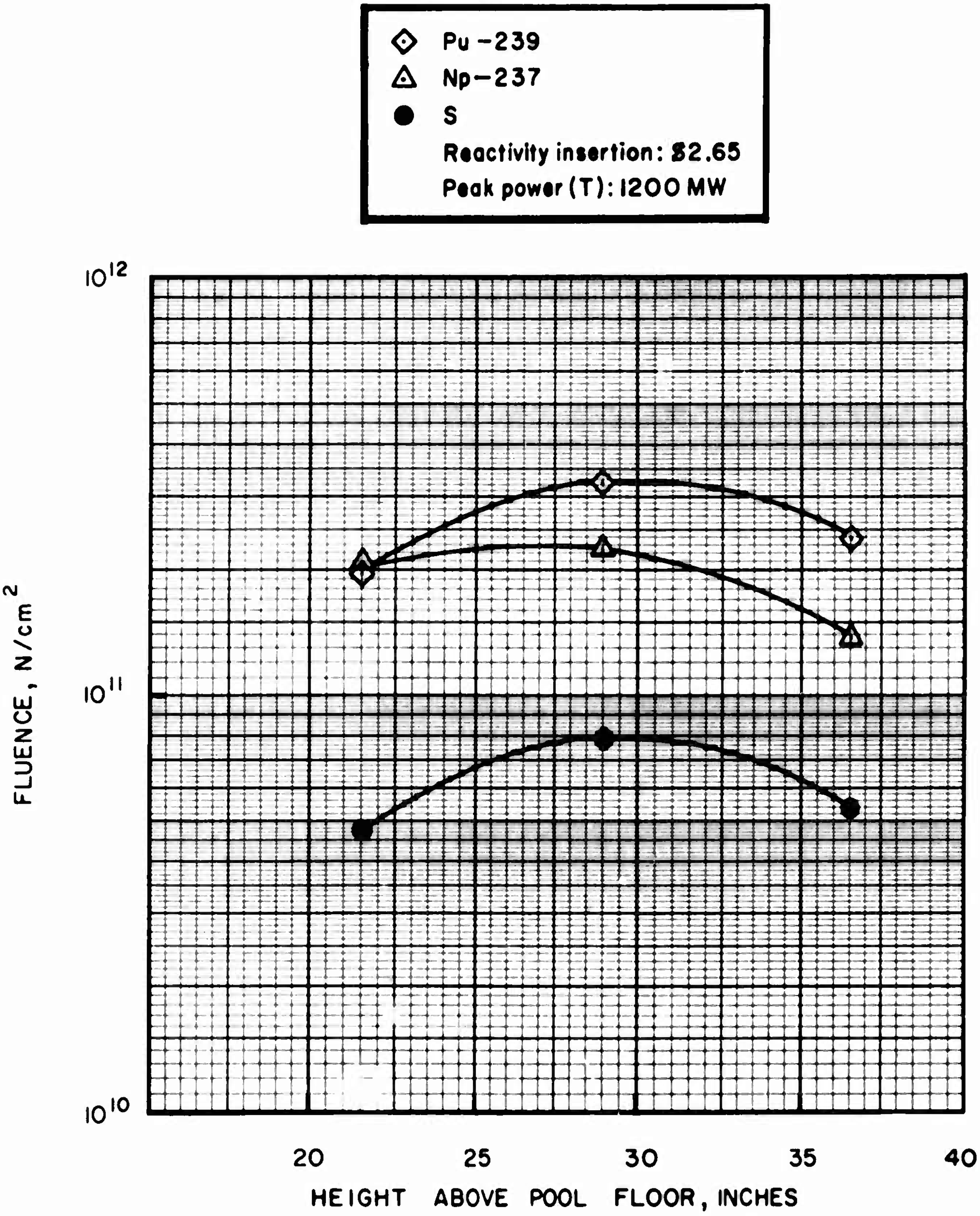


FIGURE 41. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, 10 INCHES FROM CORE EDGE, ON POOL MIDLINE (SEE FIGURE 8).

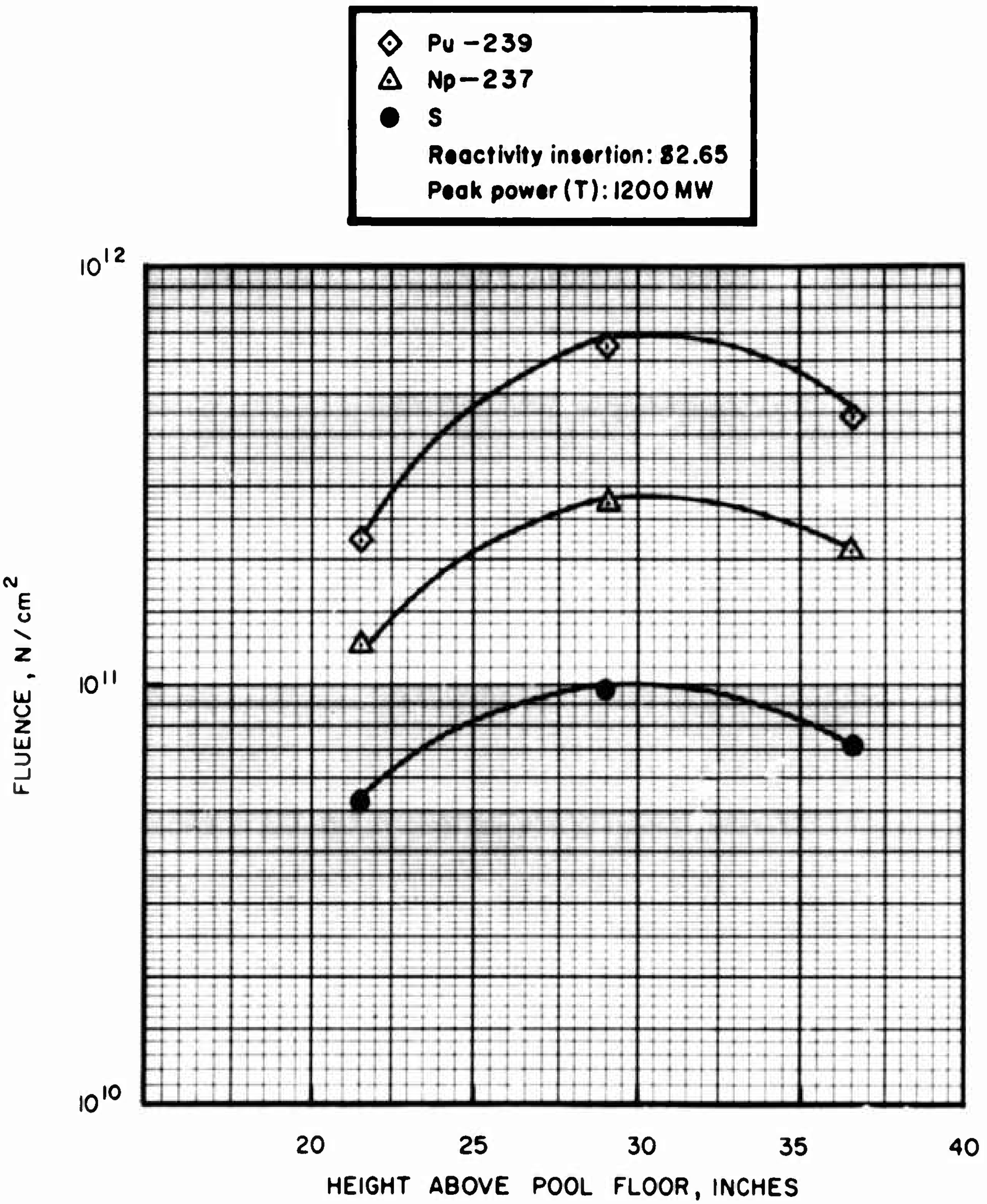


FIGURE 42. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, 10 INCHES FROM CORE EDGE, -30° FROM POOL MIDLINE (SEE FIGURE 8).

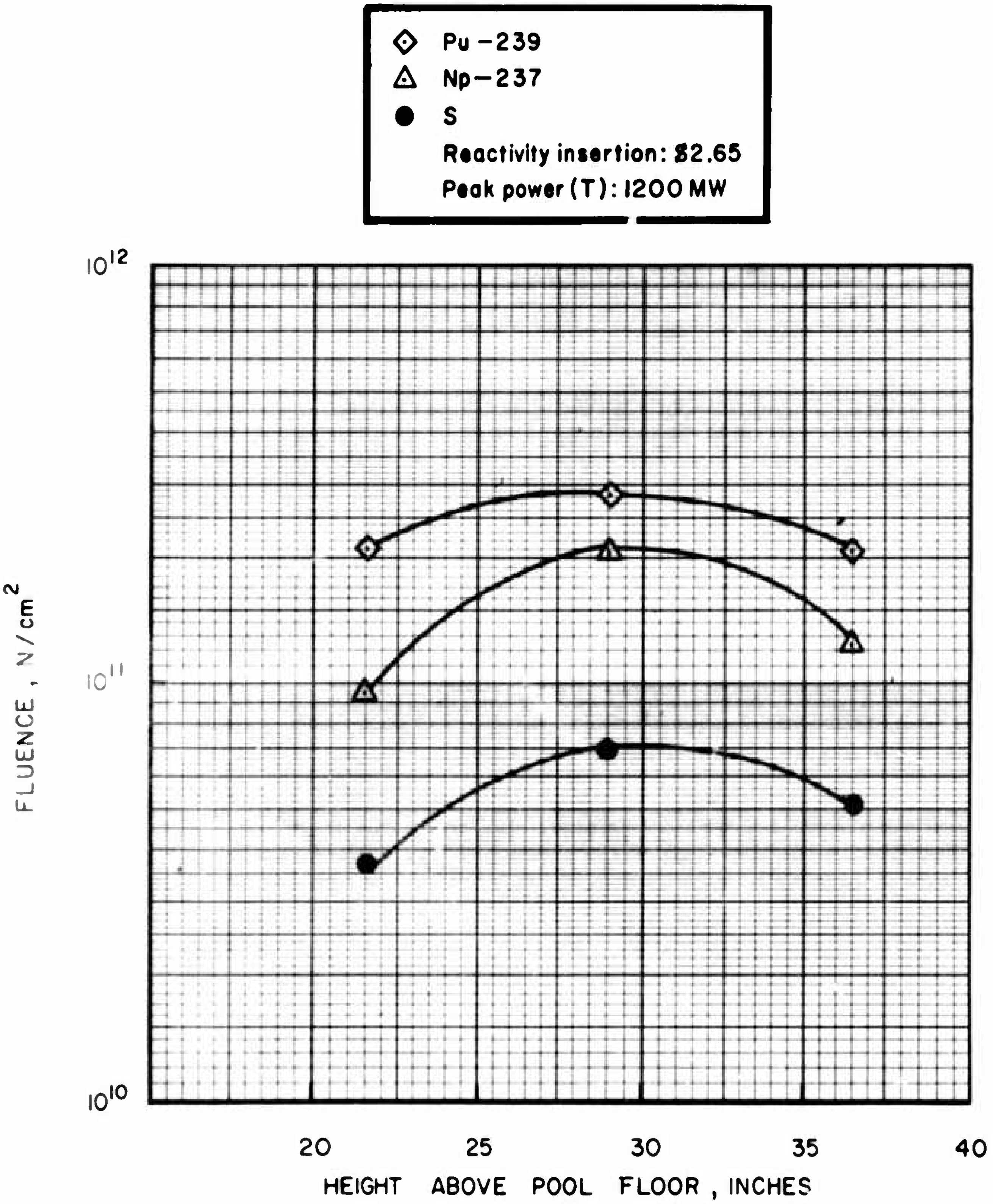


FIGURE 43. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, 10 INCHES FROM CORE, −60° FROM POOL MIDLINE (SEE FIGURE 8).

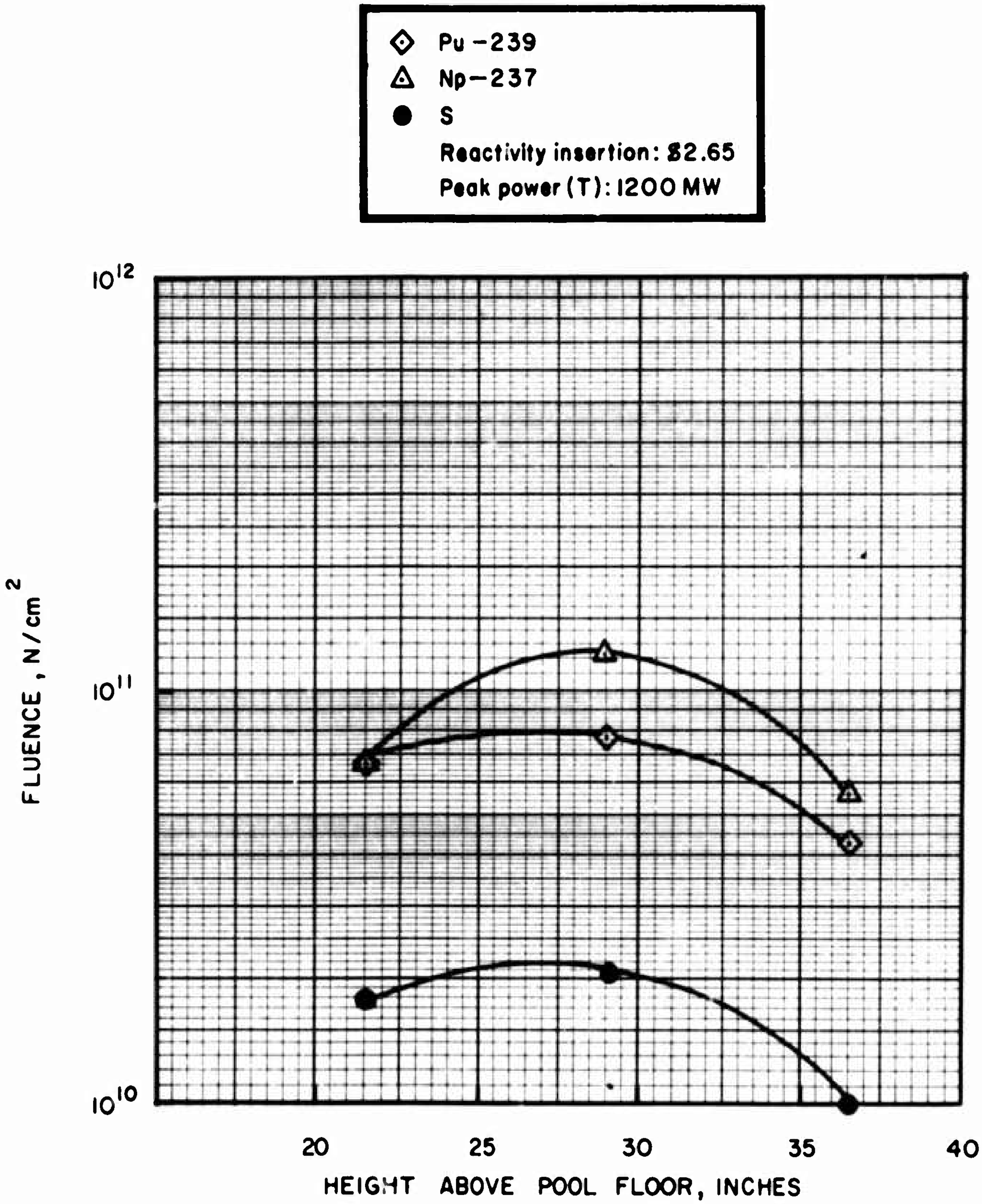


FIGURE 44. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, 15 INCHES FROM CORE, ON POOL MIDLINE (SEE FIGURE 8).

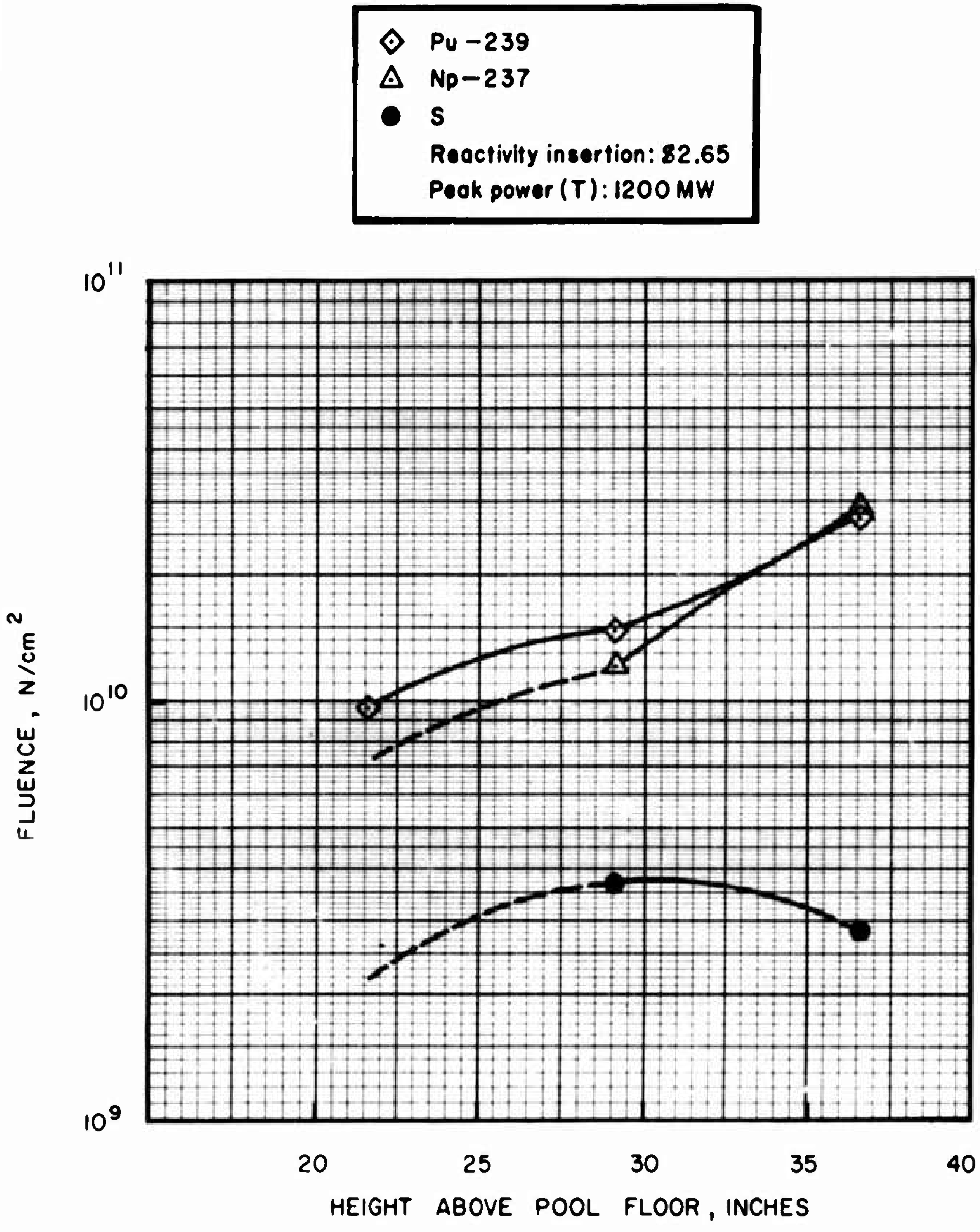


FIGURE 45. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, 20 INCHES FROM CORE, 30° FROM POOL MIDLINE (SEE FIGURE 8).

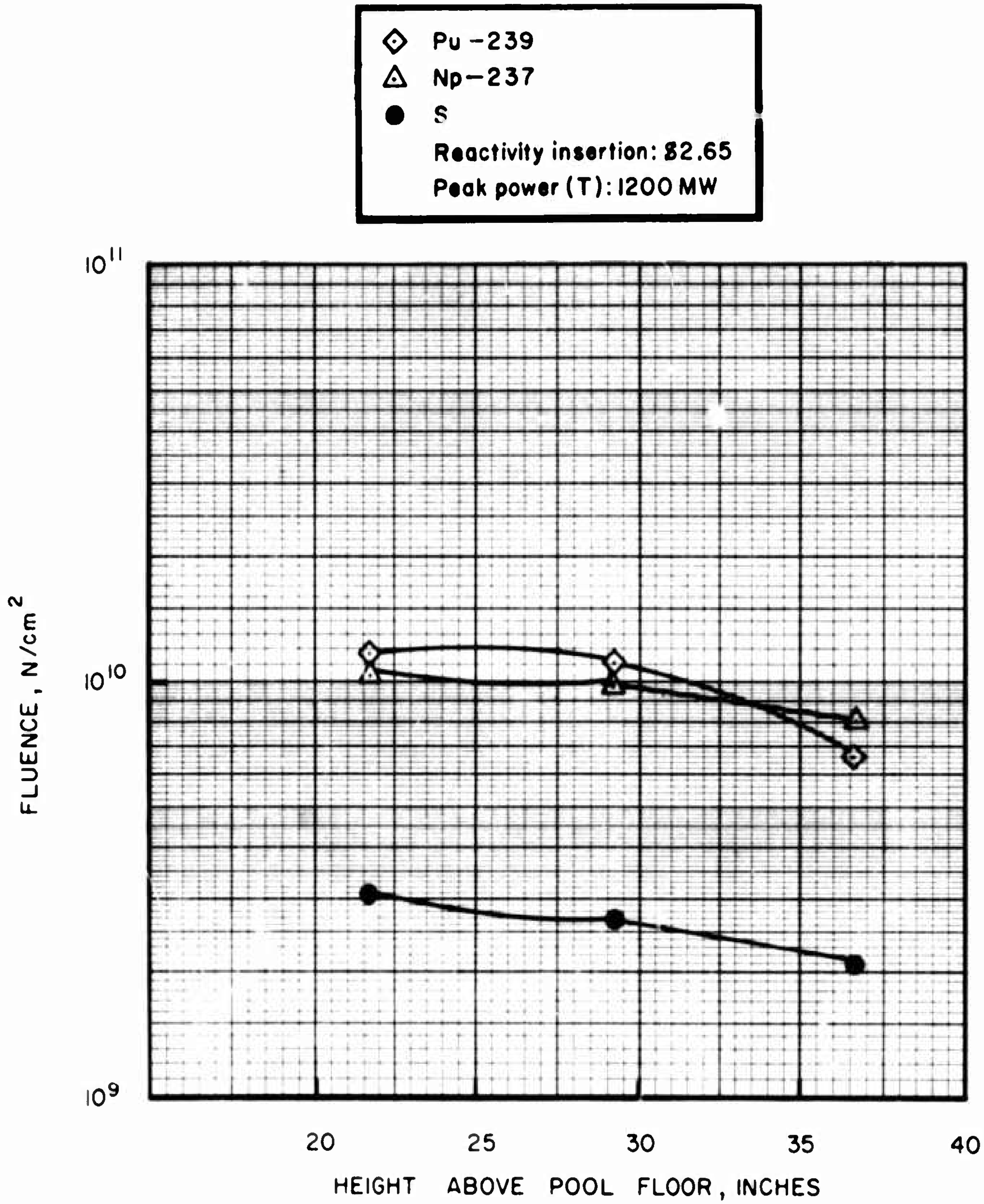


FIGURE 46. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, 20 INCHES FROM CORE, 15° FROM POOL MIDLINE (SEE FIGURE 8).

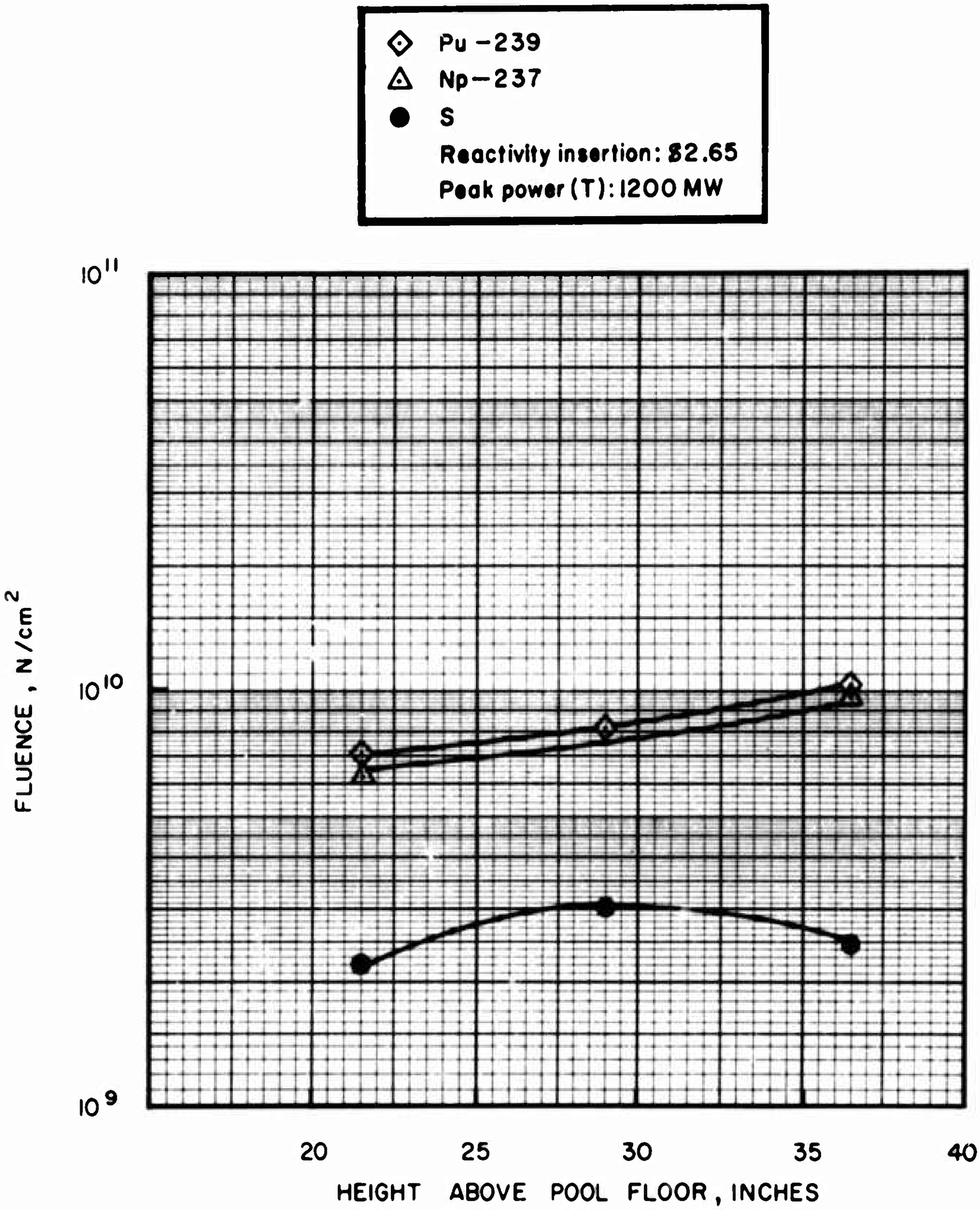


FIGURE 47. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, 20 INCHES FROM CORE, ON POOL MIDLINE (SEE FIGURE 8).

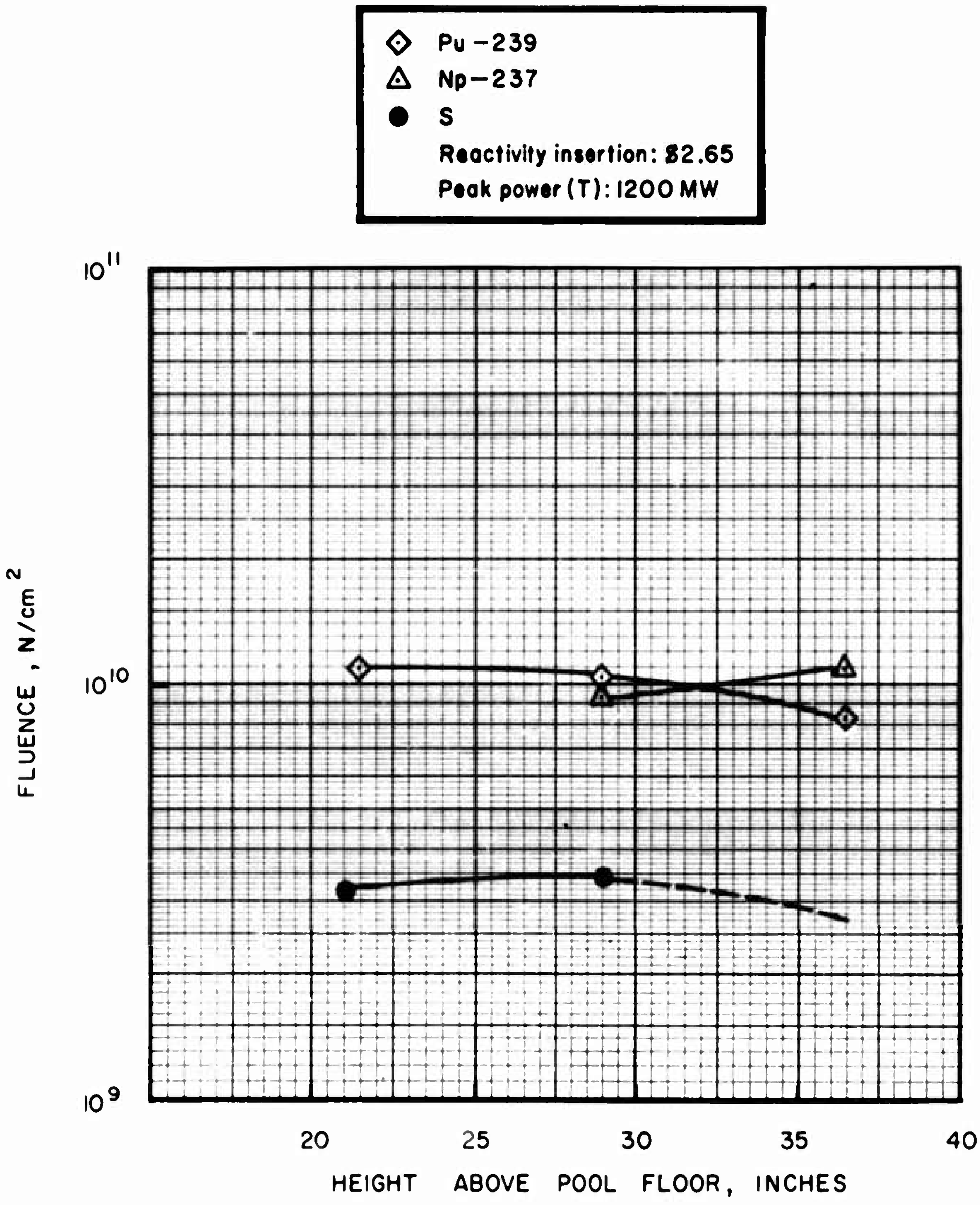


FIGURE 48. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, 20 INCHES FROM CORE, −15° FROM POOL MIDLINE (SEE FIGURE 8).

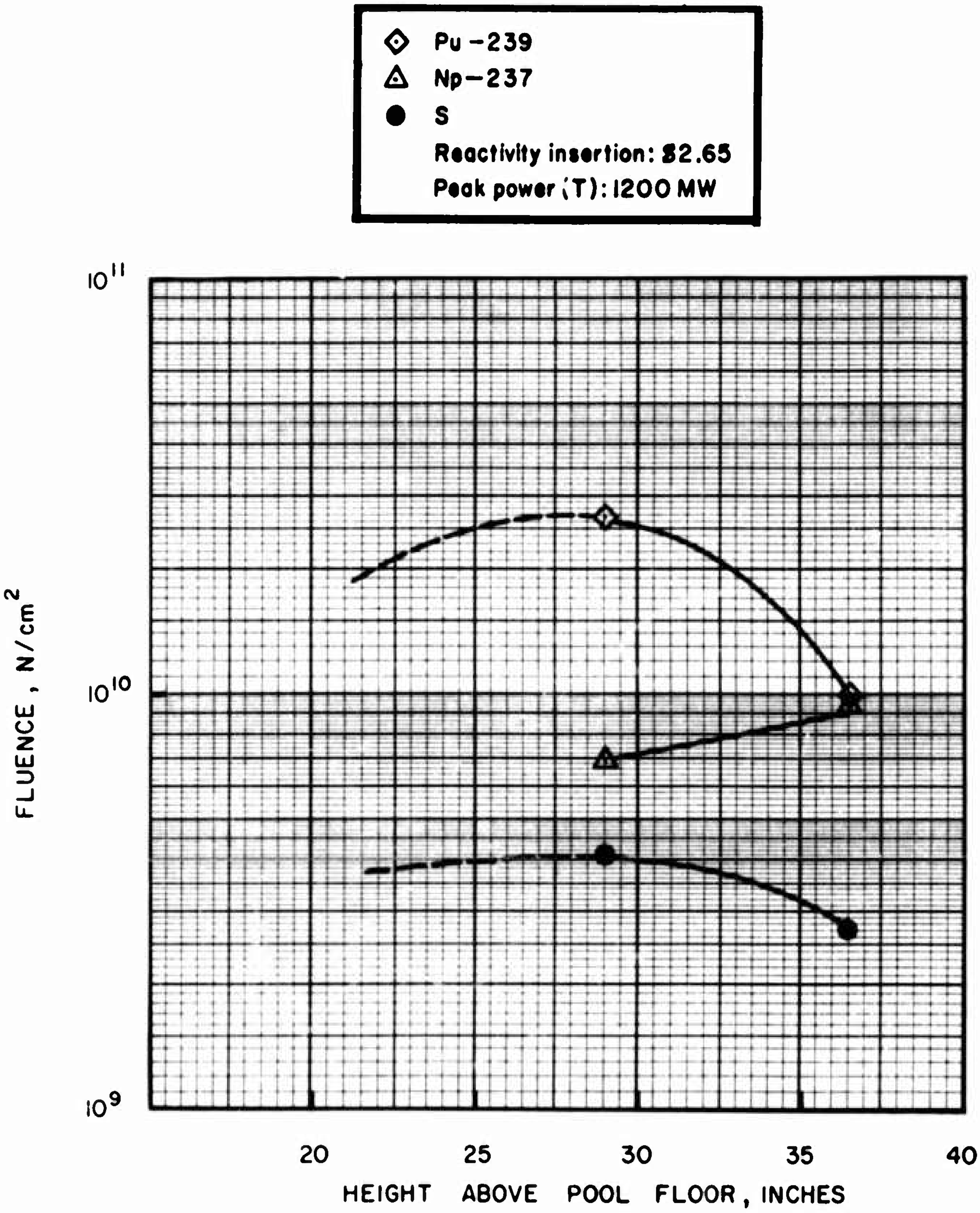


FIGURE 49. POOL VERTICAL FAST NEUTRON FIELD GRADIENT, 20 INCHES FROM CORE, −30° FROM POOL MIDLINE (SEE FIGURE 8).

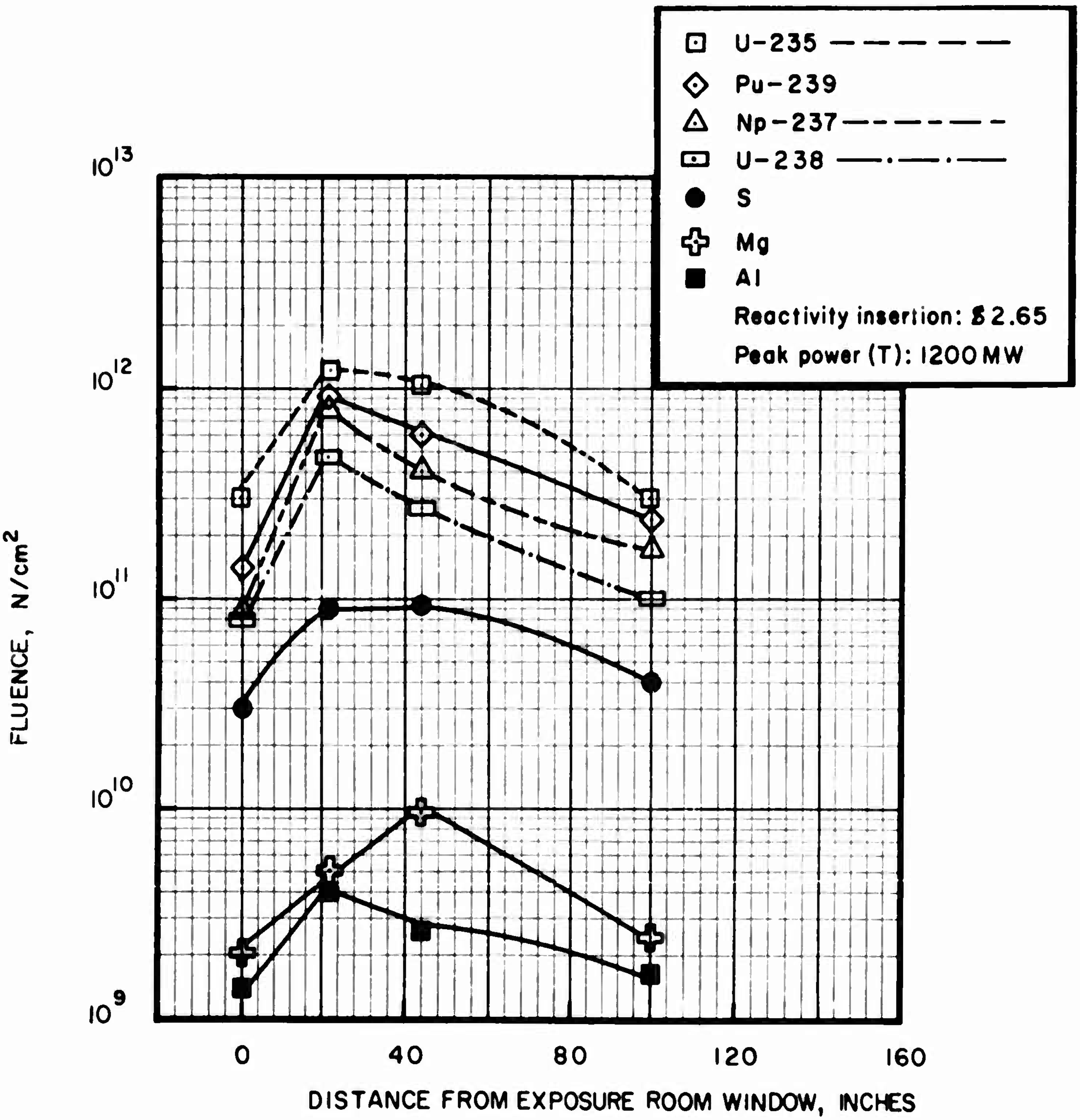


FIGURE 50. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, 60° FROM ROOM MIDLINE (SEE FIGURE 10), 24 INCHES ABOVE THE FLOOR.

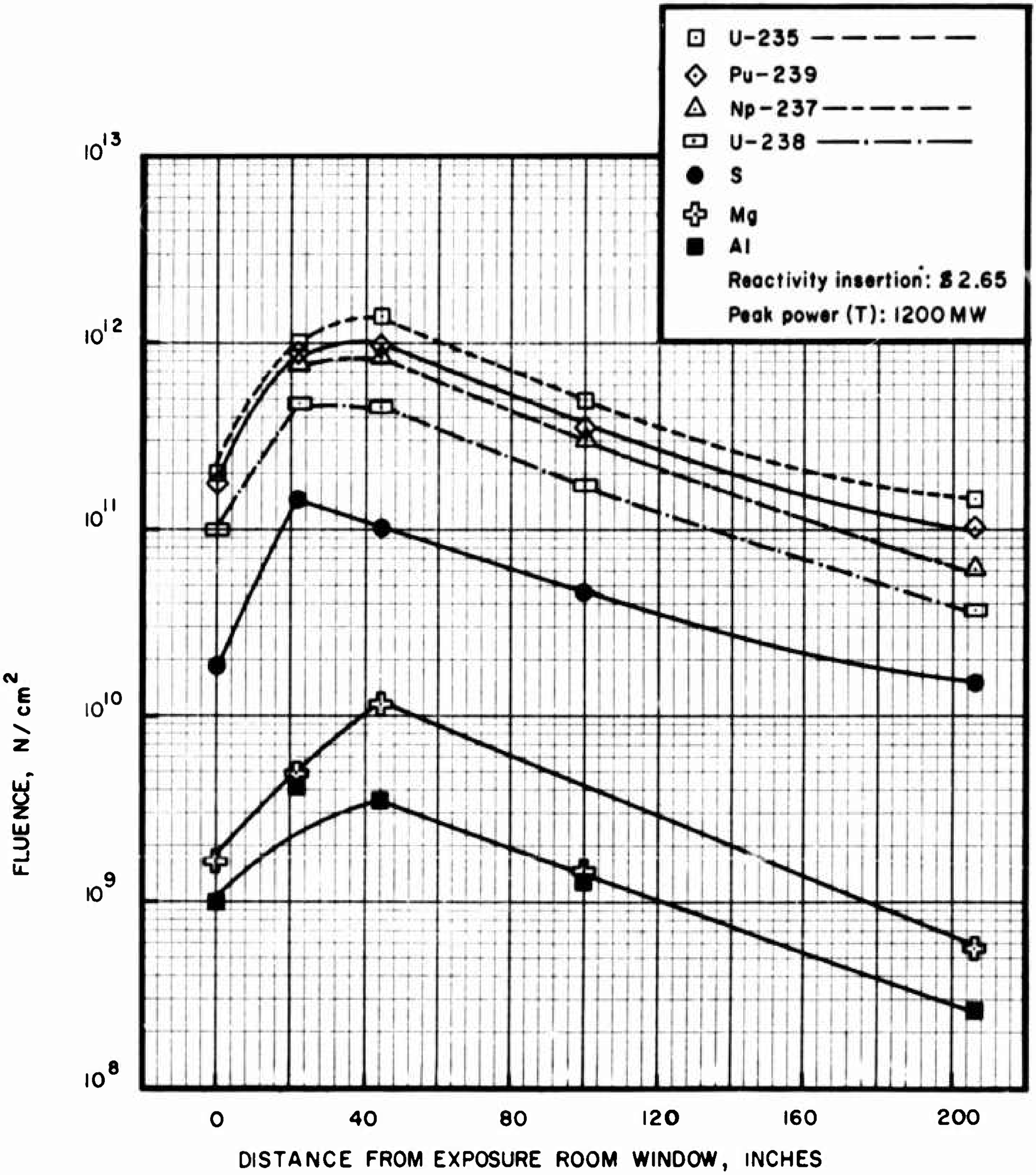


FIGURE 51. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, 30° FROM ROOM MIDLINE (SEE FIGURE 10), 24 INCHES ABOVE THE FLOOR.

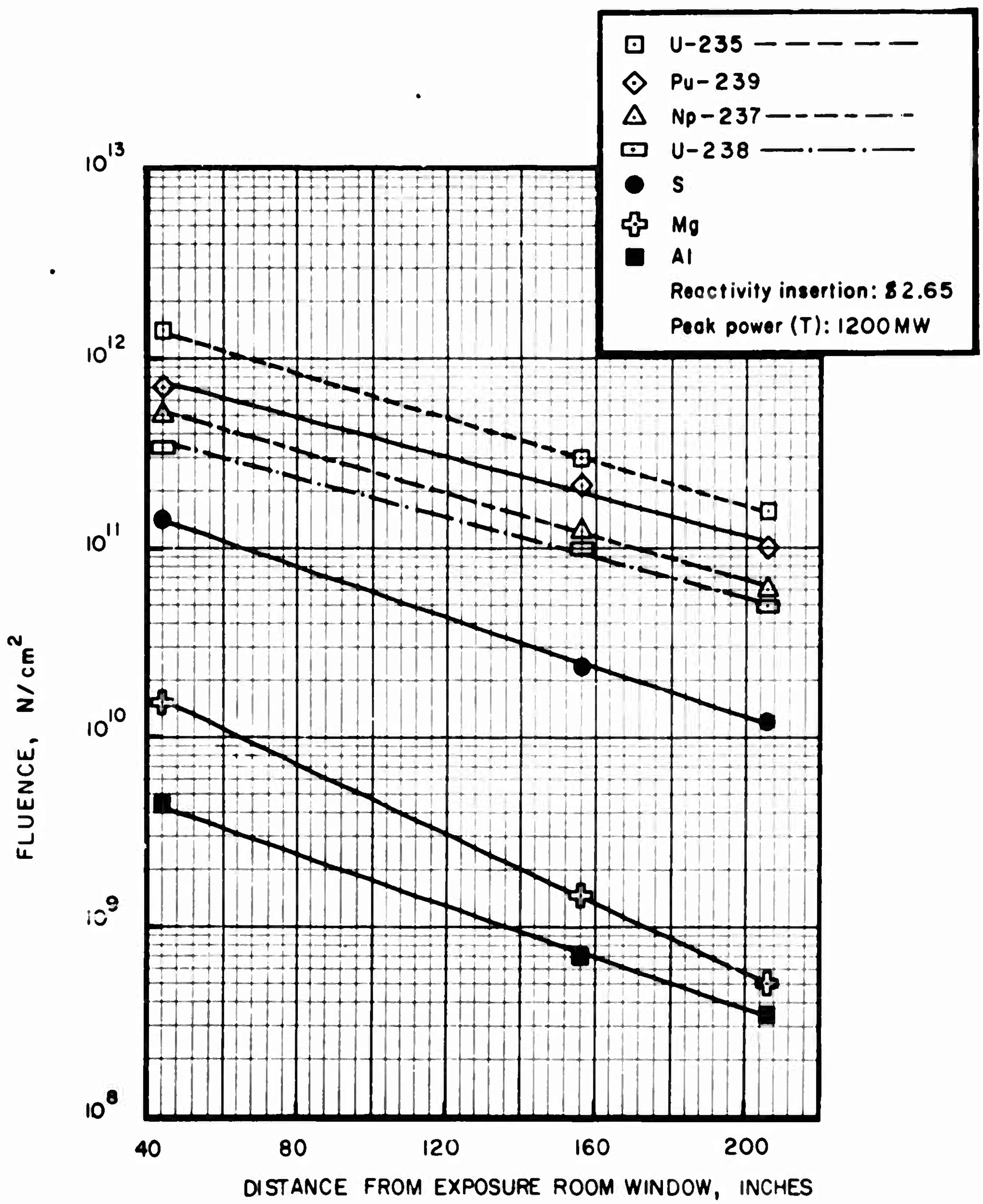


FIGURE 52. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, 15° FROM ROOM MIDLINE (SEE FIGURE 10), 24 INCHES ABOVE THE FLOOR.

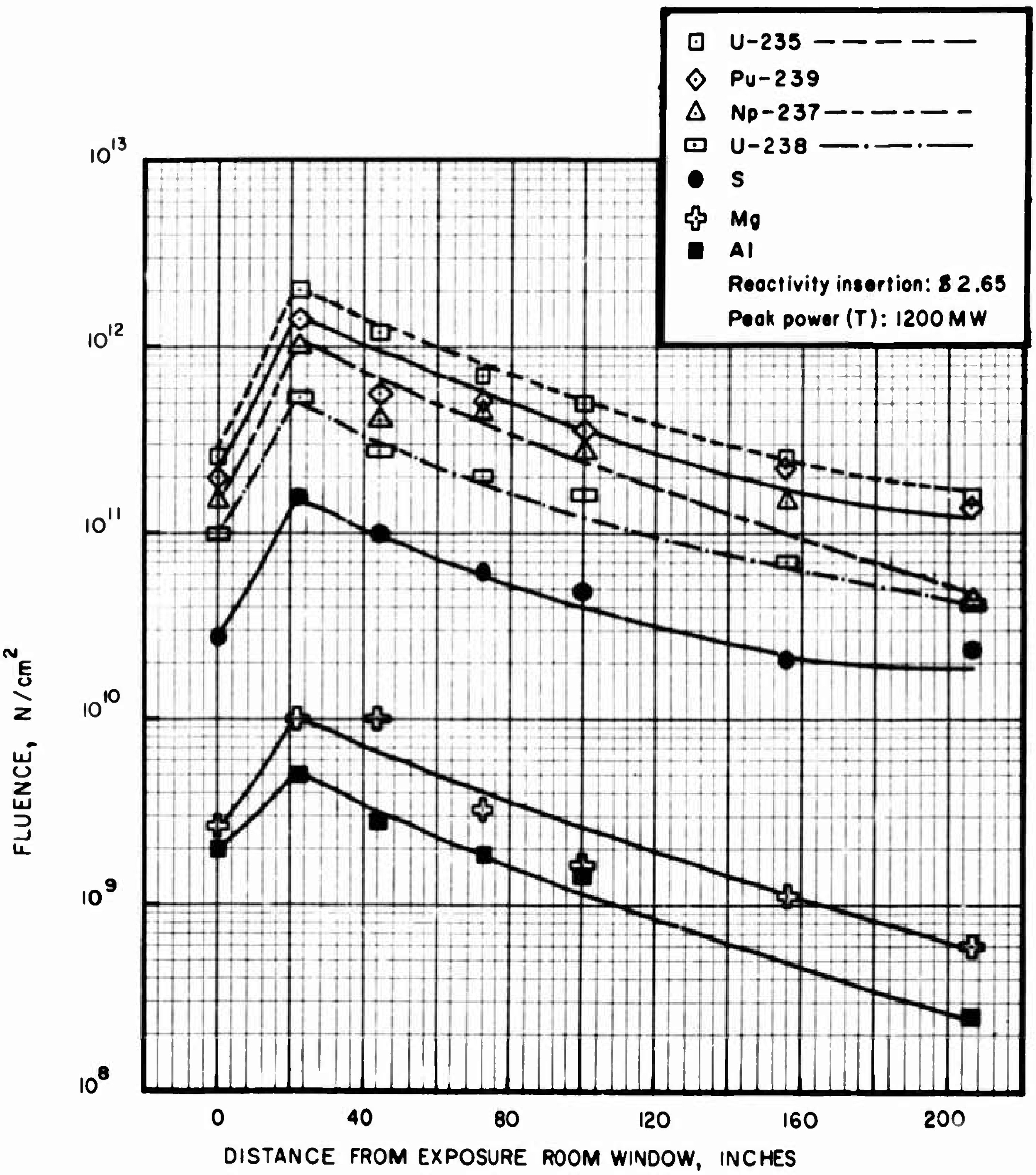


FIGURE 53. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, ON ROOM MIDLINE (SEE FIGURE 10), 24 INCHES ABOVE THE FLOOR.

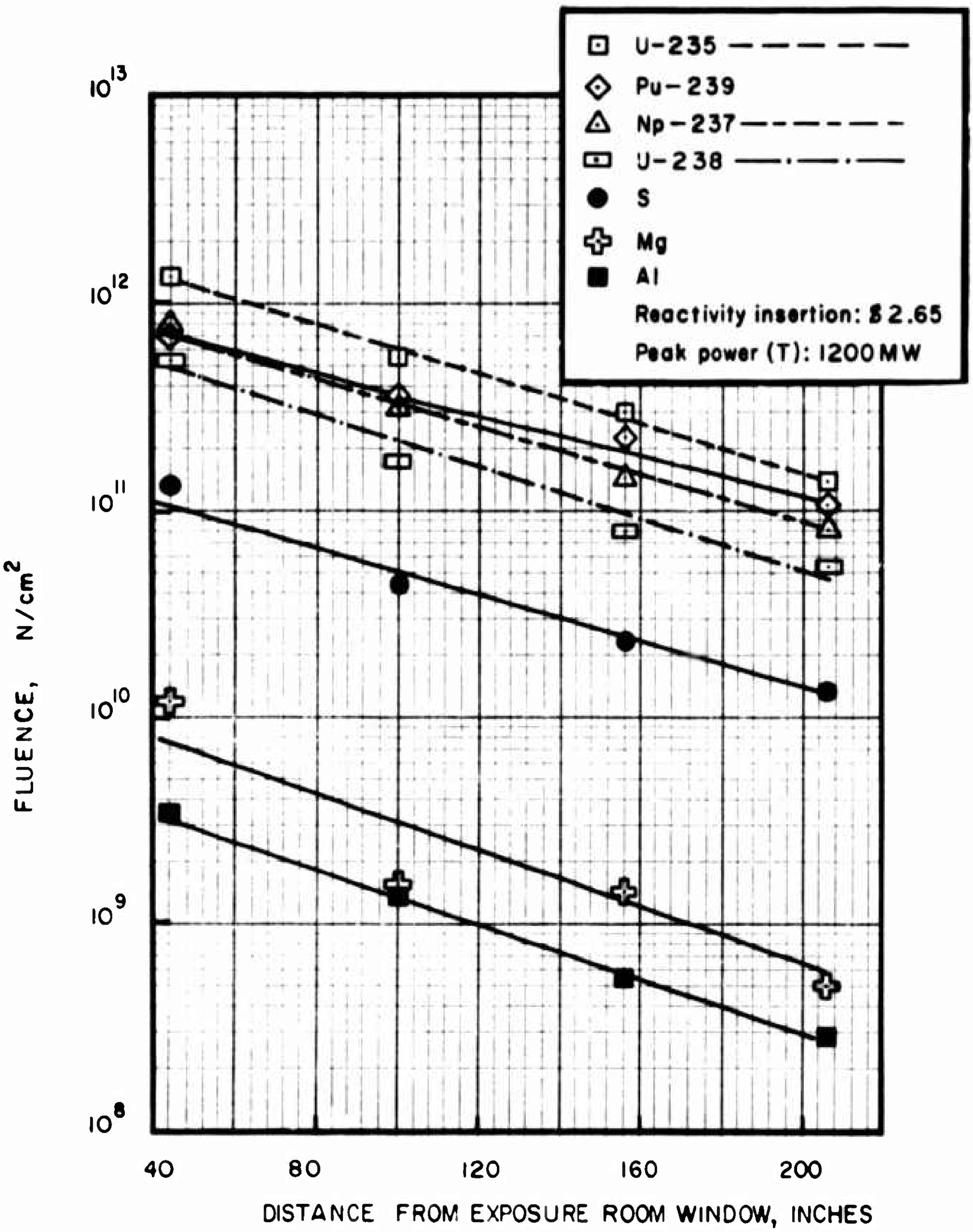


FIGURE 54. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, -15° FROM ROOM MIDLINE (SEE FIGURE 10), 24 INCHES ABOVE THE FLOOR.

FLUENCE, N/cm²

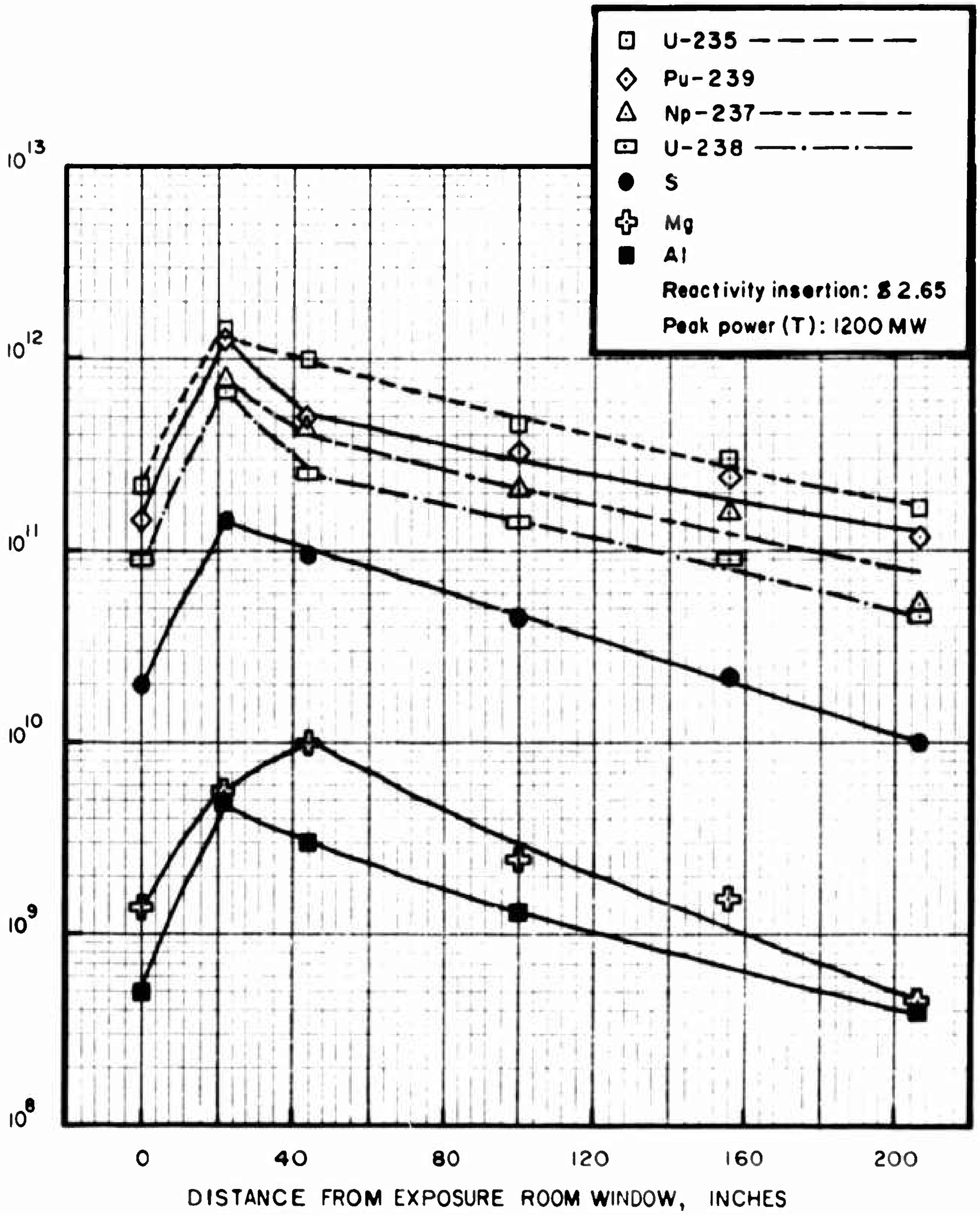


FIGURE 55. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, --30° FROM ROOM MIDLINE (SEE FIGURE 10), 24 INCHES ABOVE THE FLOOR.

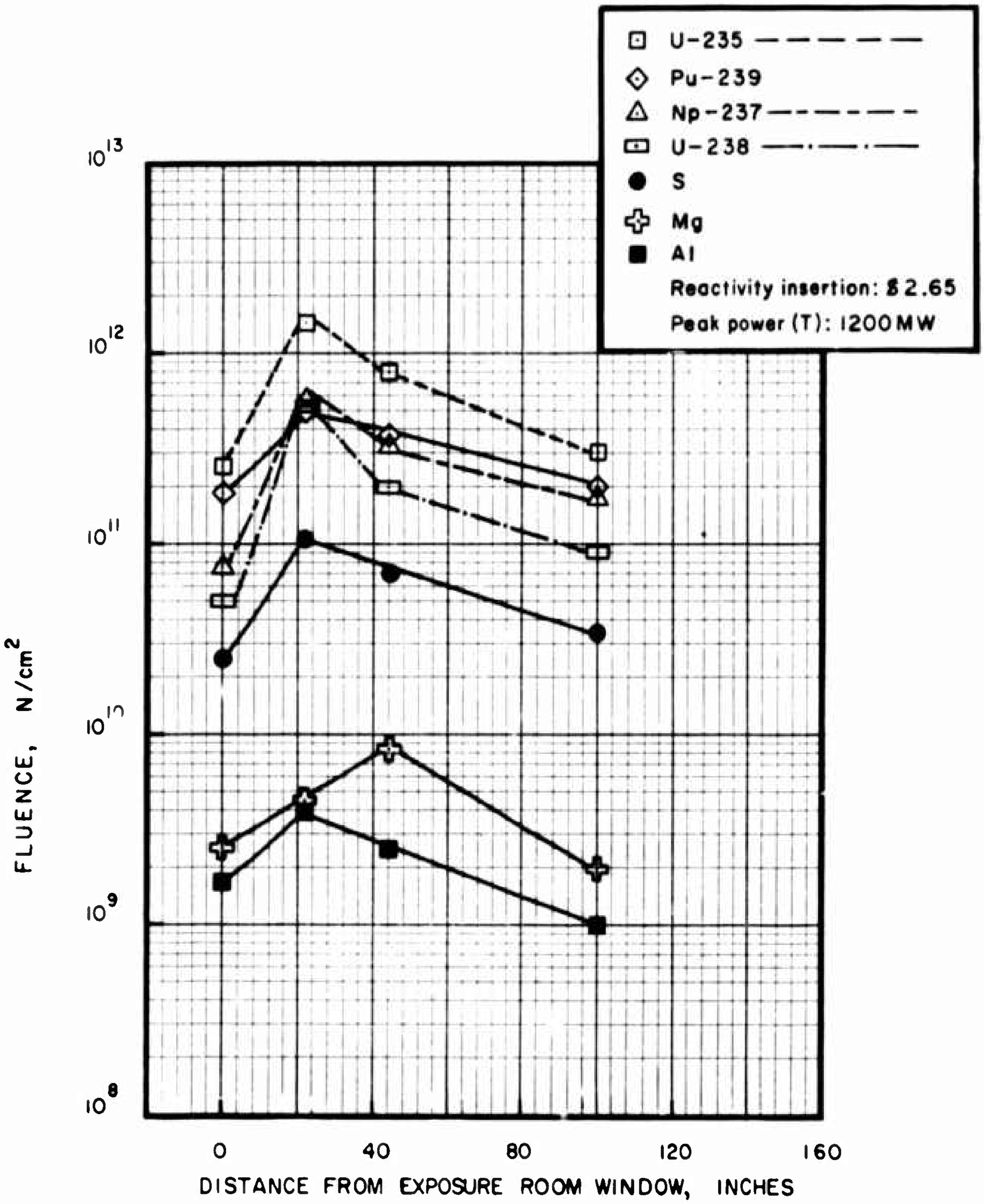


FIGURE 56. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, −60° FROM ROOM MIDLINE (SEE FIGURE 10), 24 INCHES ABOVE THE FLOOR.

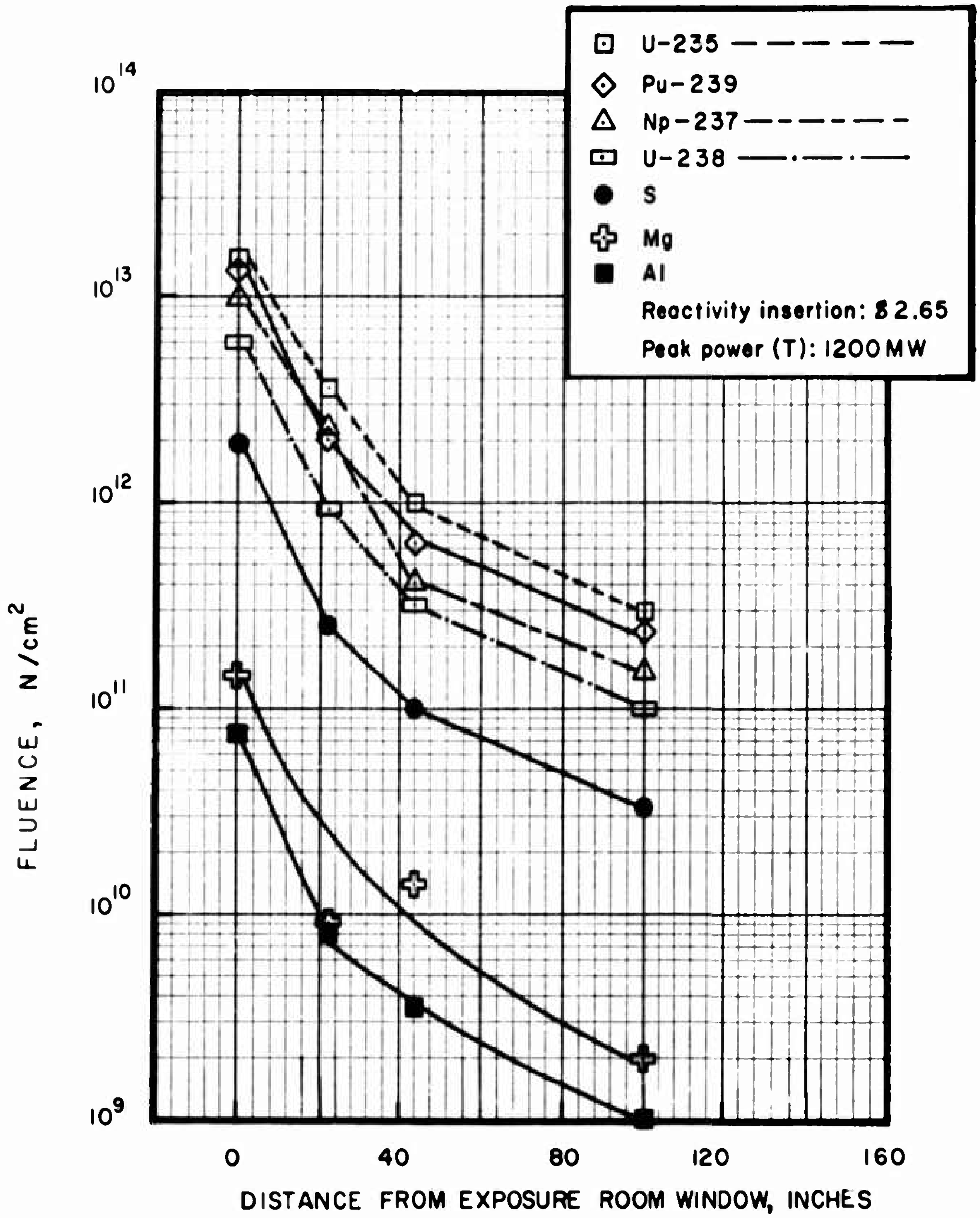


FIGURE 57. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, 90° FROM ROOM MIDLINE (SEE FIGURE 10), 48 INCHES ABOVE THE FLOOR.

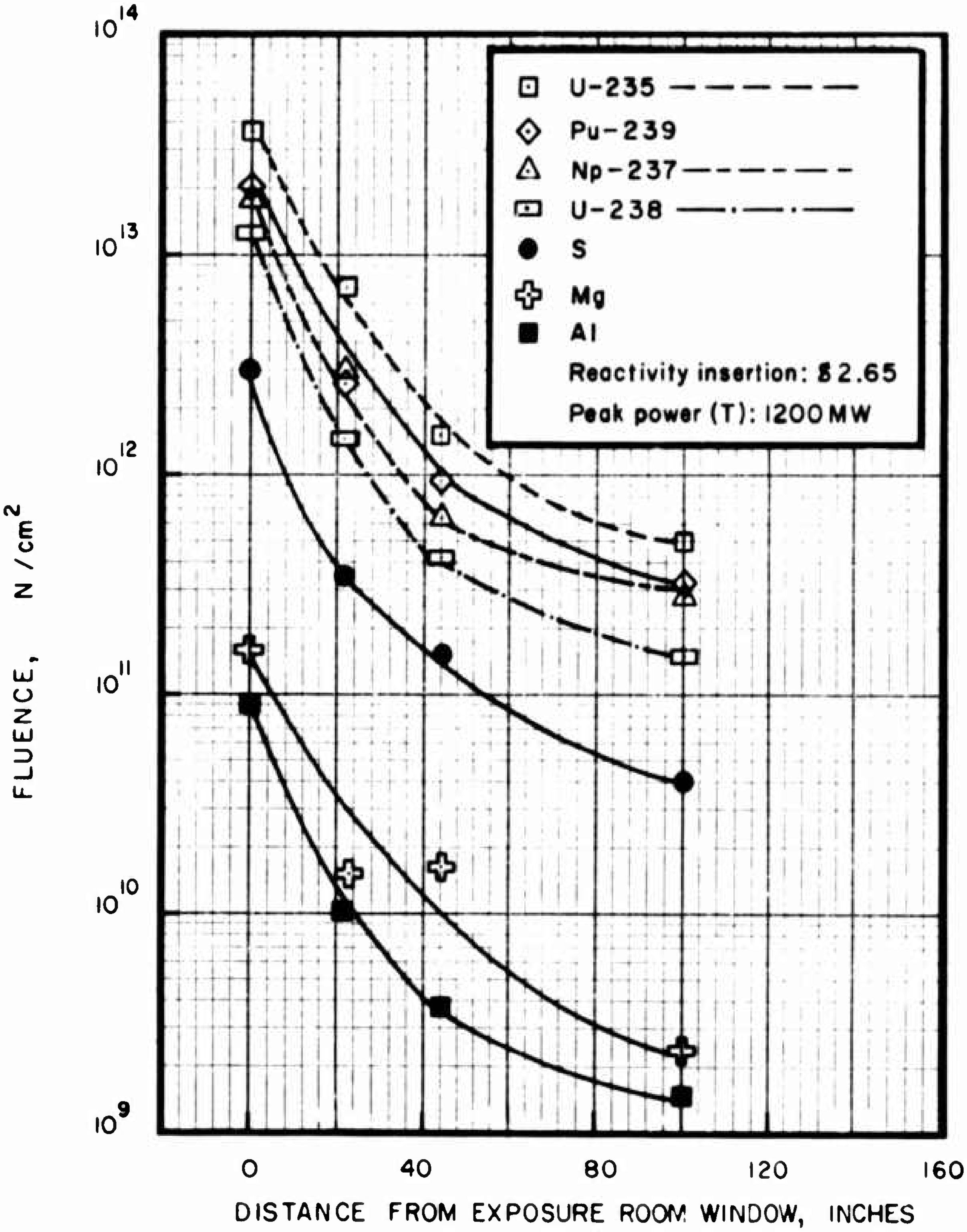


FIGURE 5P EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, 60° FROM ROOM MIDLINE(SEE FIGURE 10), 48 INCHES ABOVE THE FLOOR.

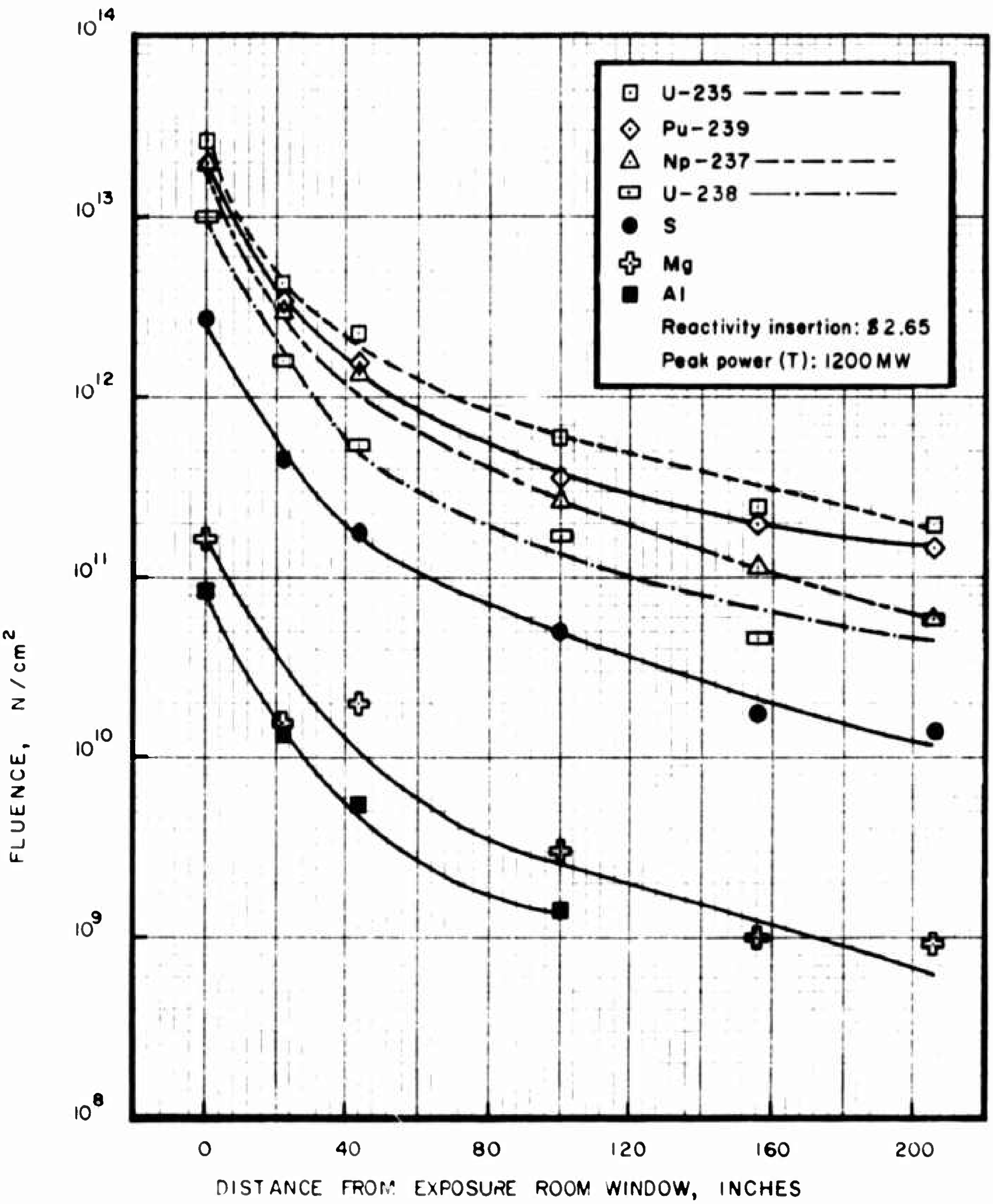


FIGURE 59. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, 30° FROM ROOM MIDLINE (SEE FIGURE 10), 48 INCHES ABOVE THE FLOOR.

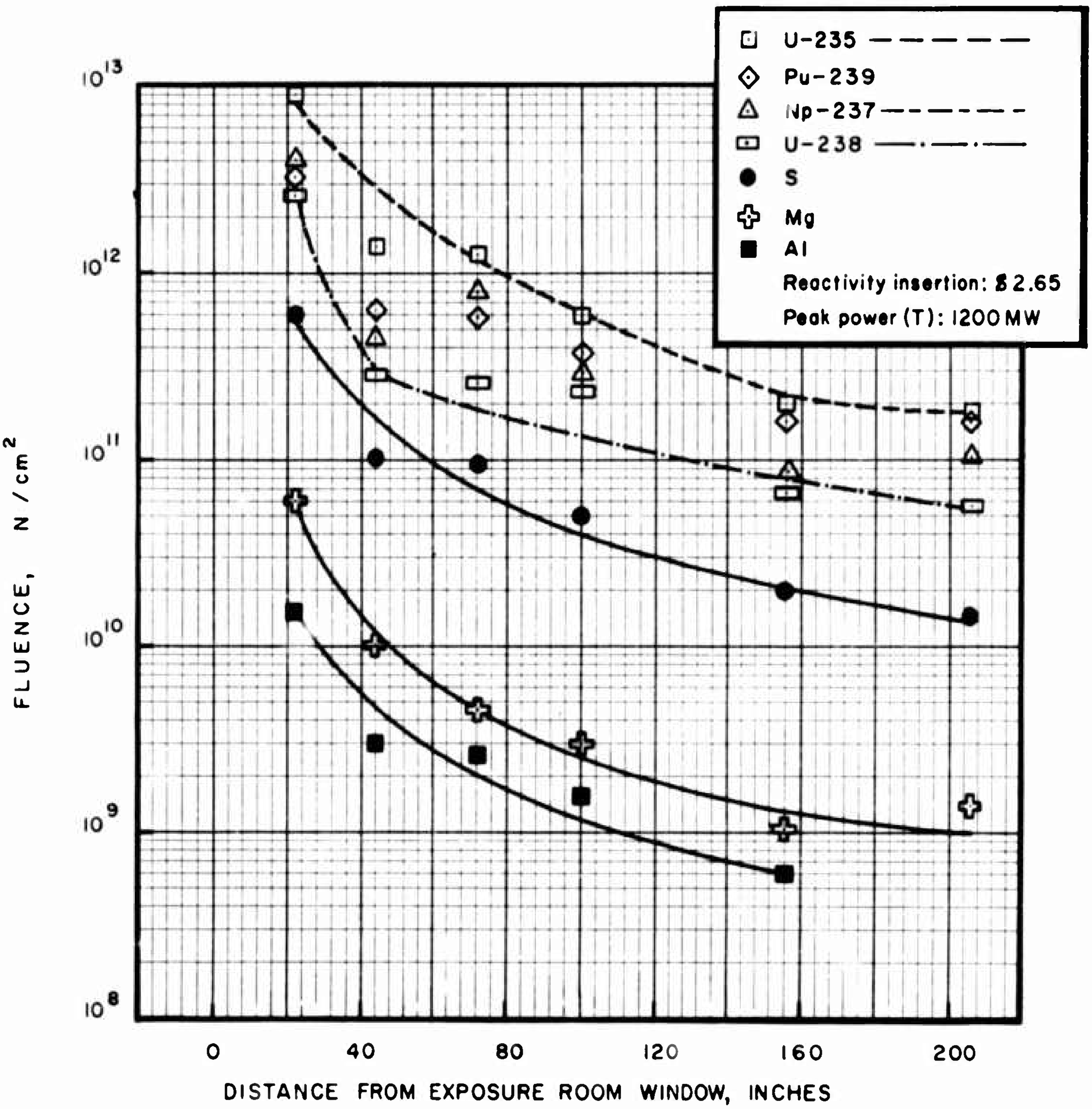


FIGURE 60. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, 15° FROM ROOM MIDLINE (SEE FIGURE 10), 48 INCHES ABOVE THE FLOOR.

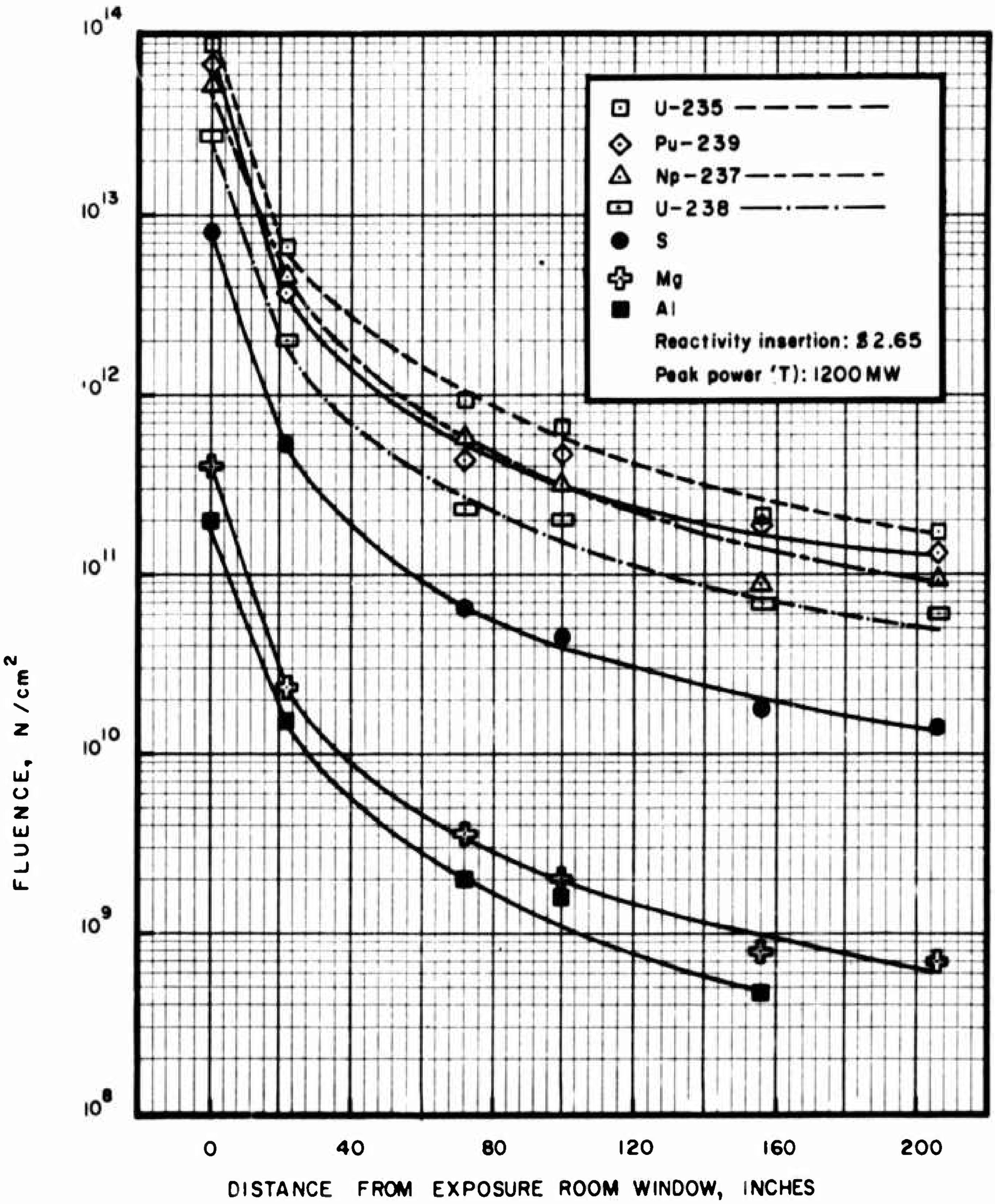


FIGURE 61. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, ON ROOM MIDLINE (SEE FIGURE 10), 48 INCHES ABOVE THE FLOOR.

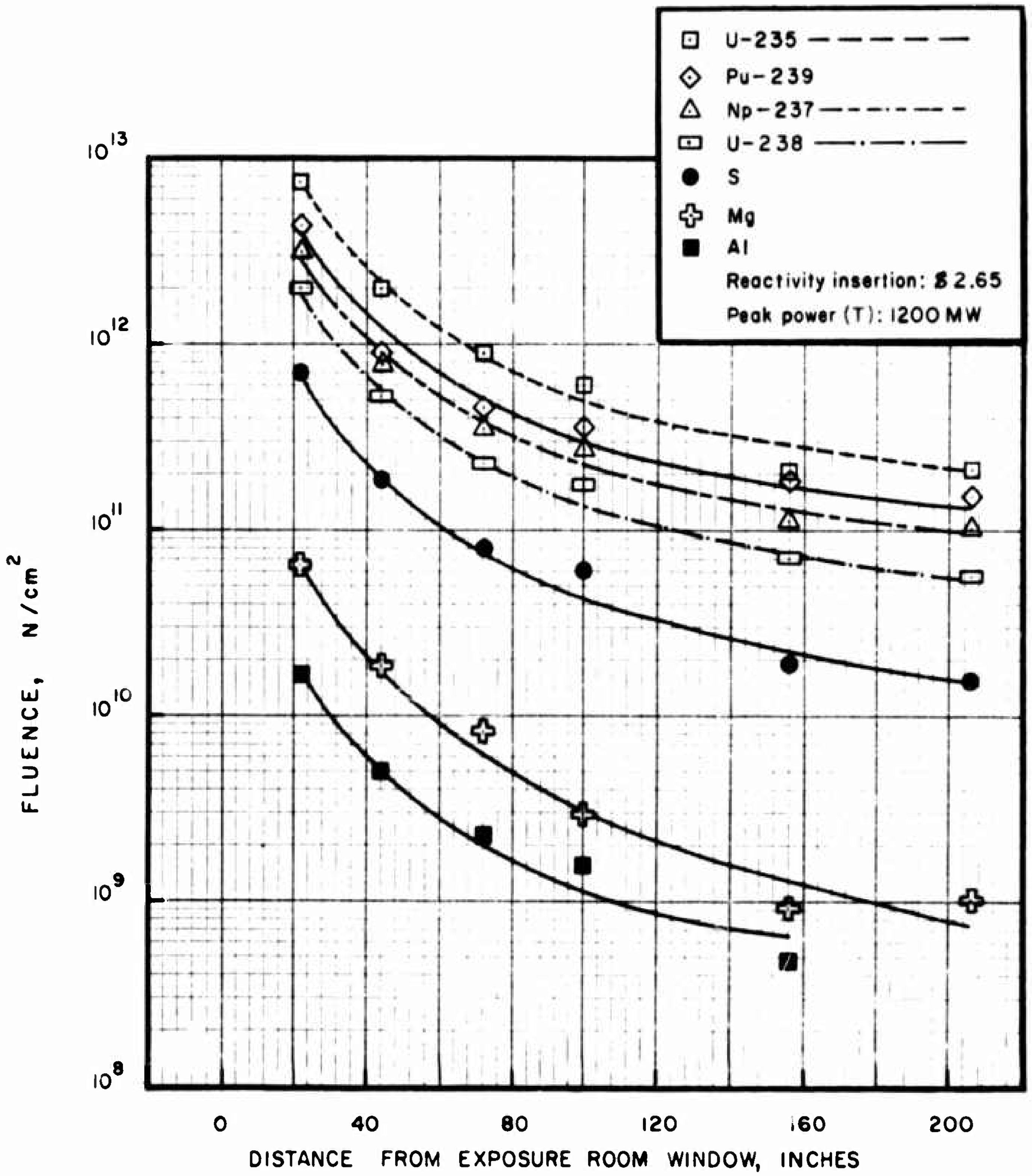


FIGURE 62. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, −15° FROM ROOM MIDLINE (SEE FIGURE 10), 48 INCHES ABOVE THE FLOOR.

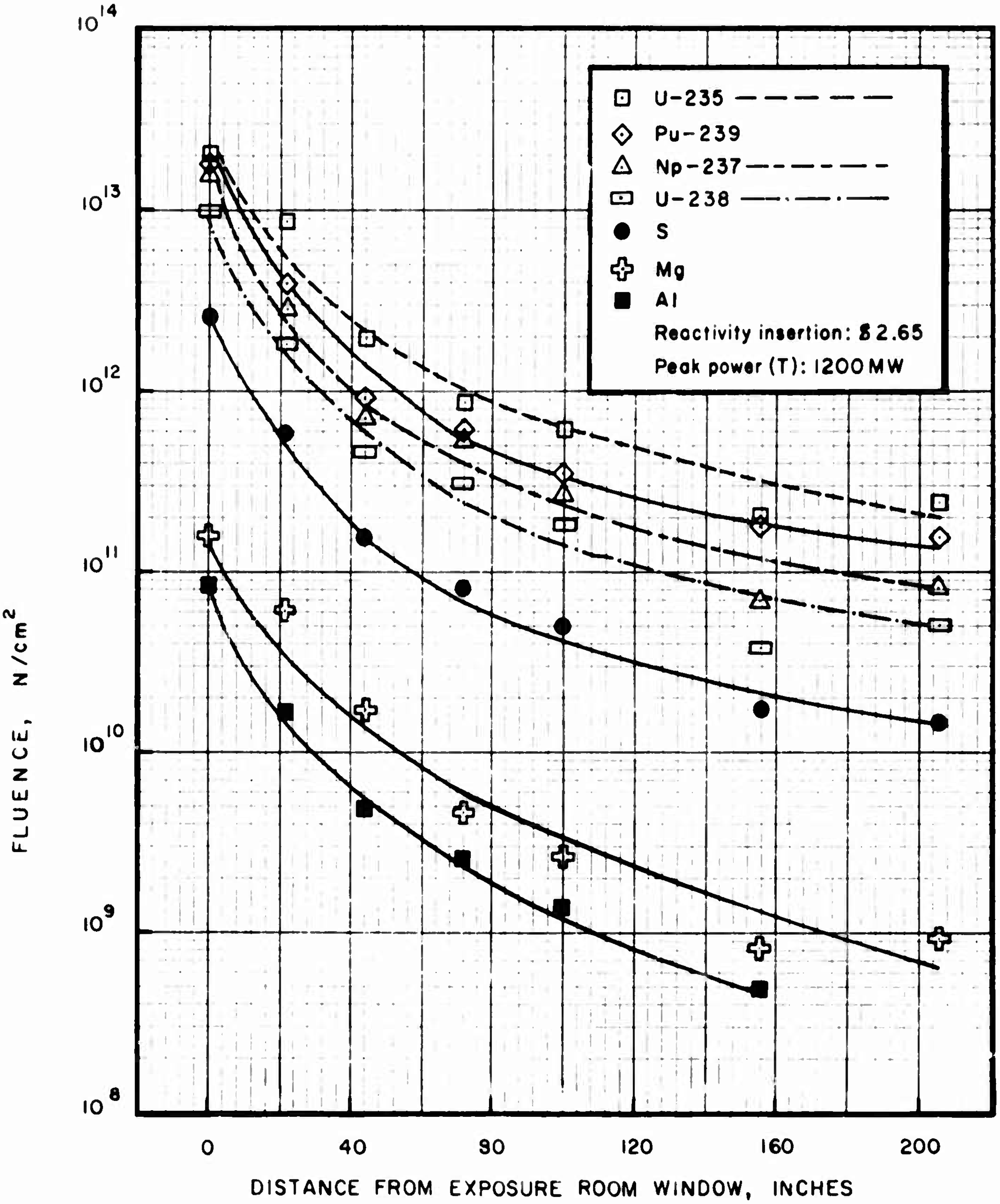


FIGURE 63. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, -30° FROM ROOM MIDLINE (SEE FIGURE 10), 48 INCHES ABOVE THE FLOOR.

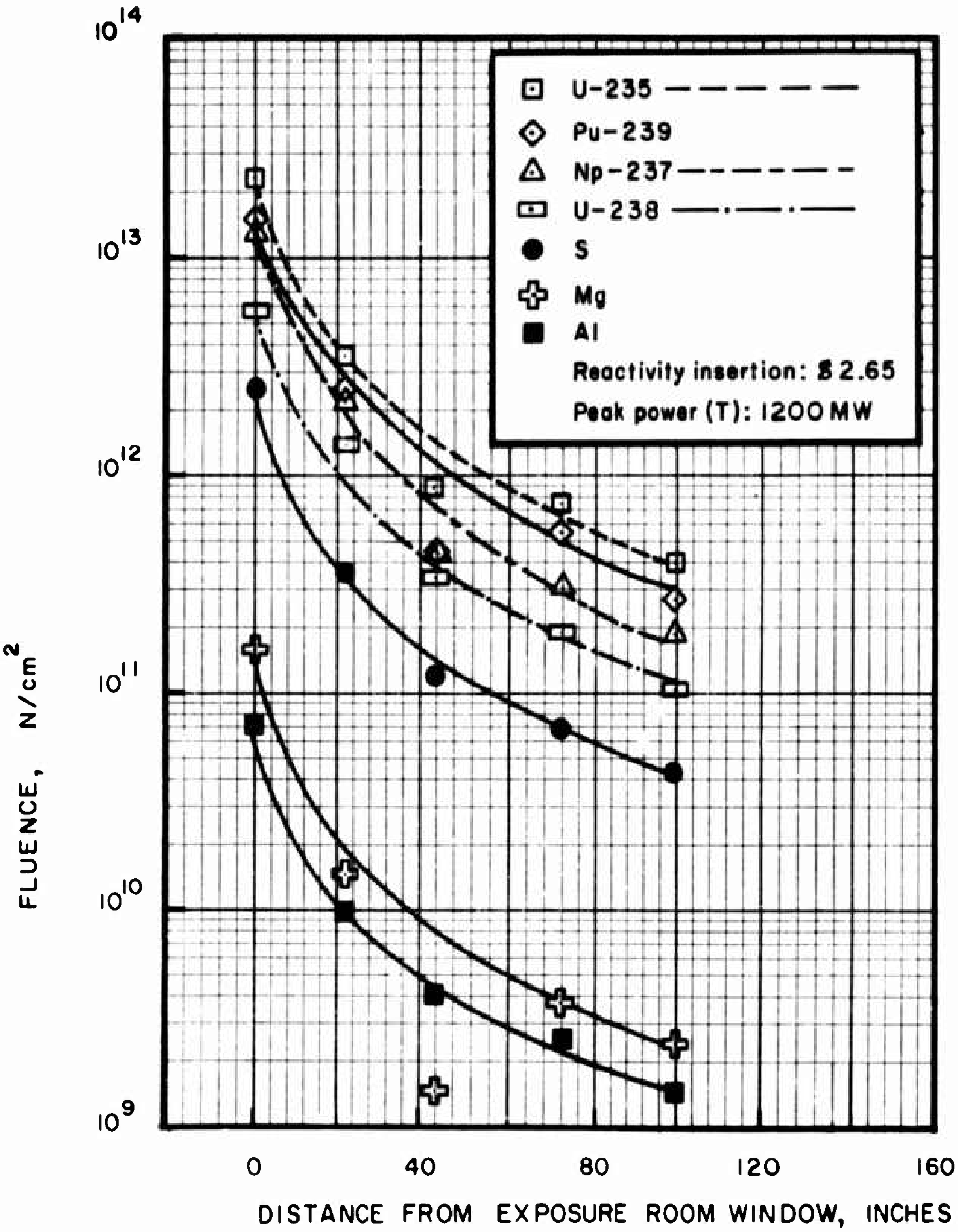


FIGURE 64. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, −60° FROM ROOM MIDLINE (SEE FIGURE 10), 48 INCHES ABOVE THE FLOOR.

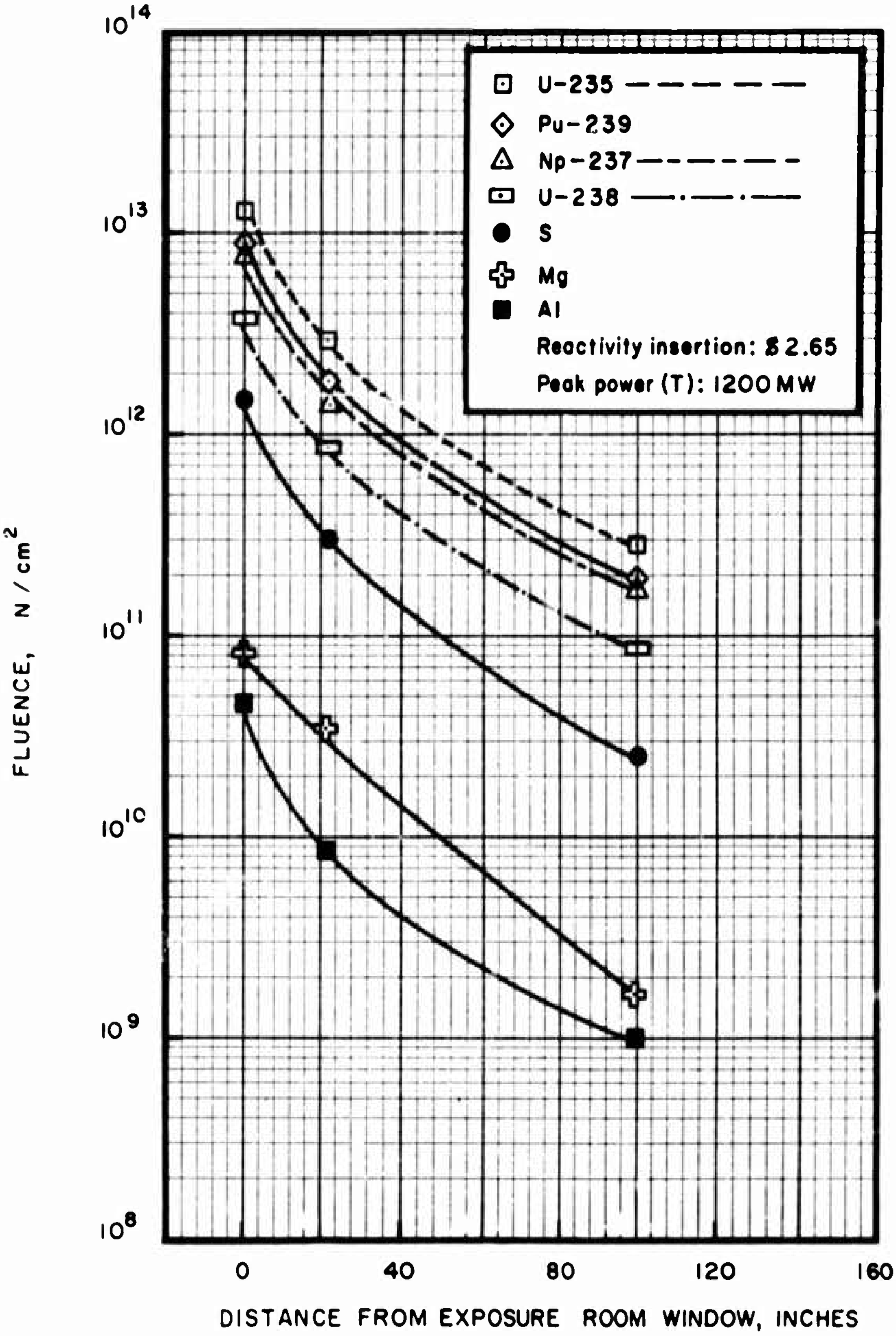


FIGURE 65, EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, −90° FROM ROOM MIDLINE (SEE FIGURE 10), 48 INCHES ABOVE THE FLOOR.

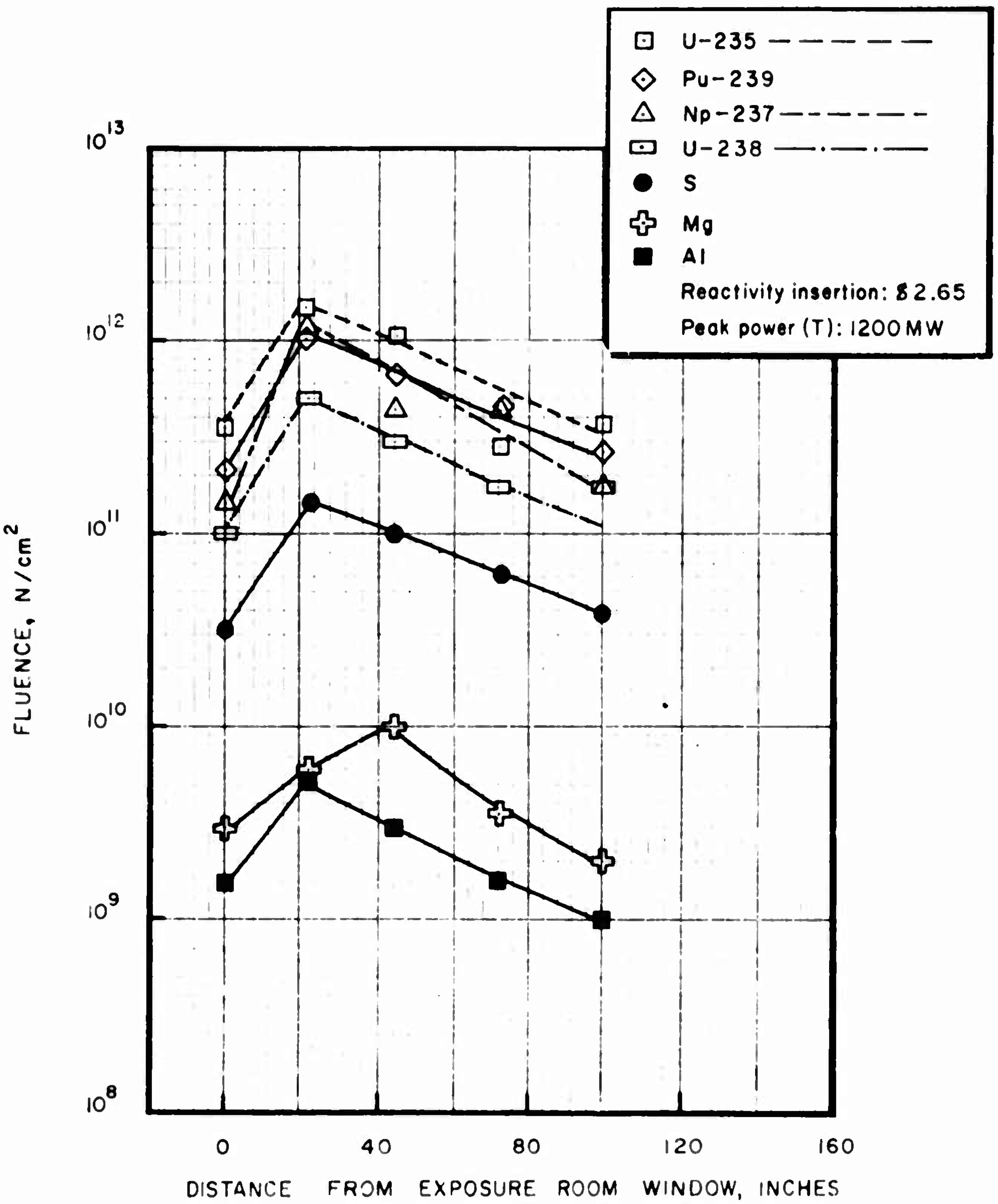


FIGURE 66. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, +60° FROM ROOM MIDLINE (SEE FIGURE 10), 72 INCHES ABOVE THE FLOOR.

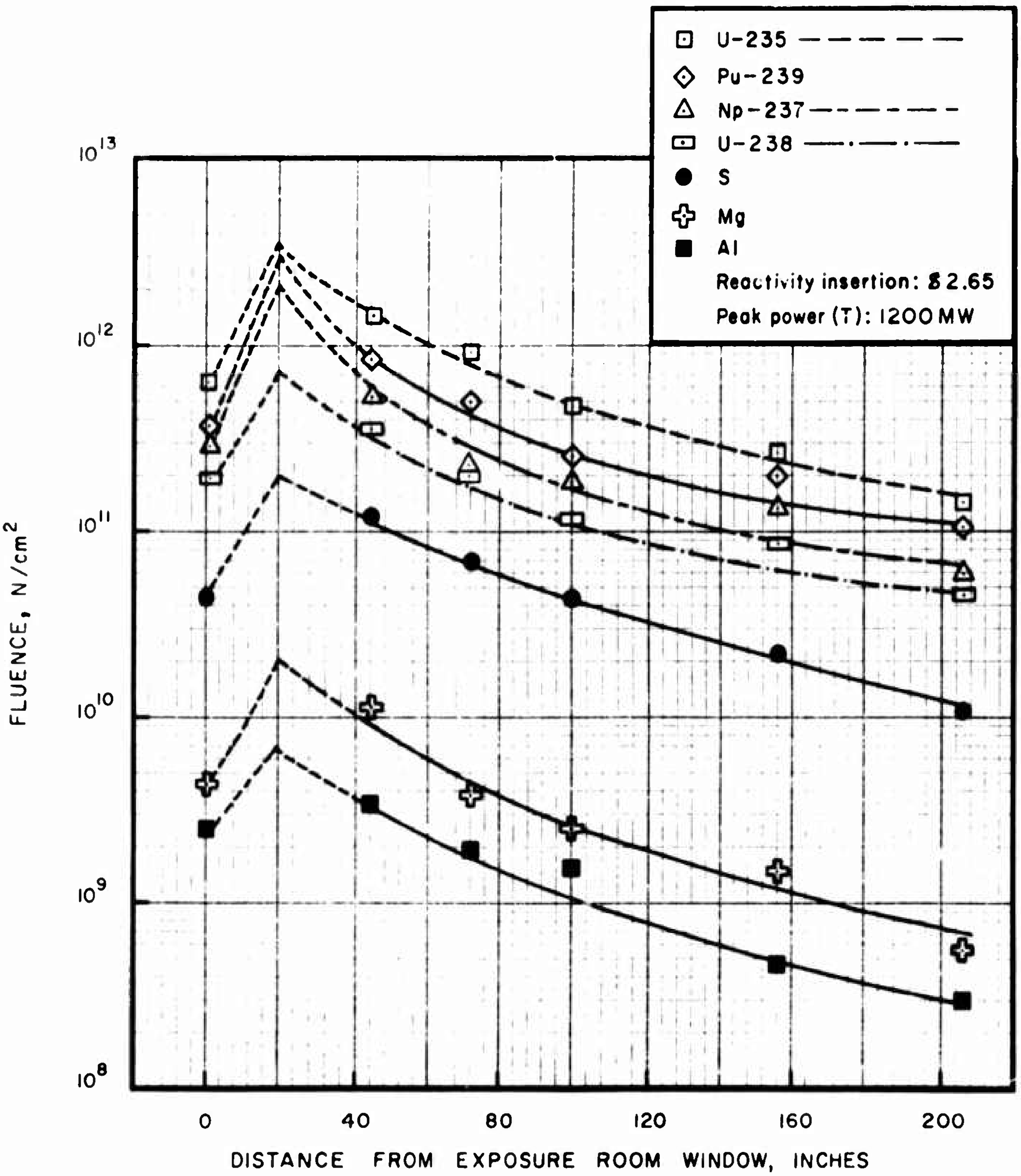


FIGURE 67. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, 30° FROM ROOM MIDLINE (SEE FIGURE 10), 72 INCHES ABOVE THE FLOOR.

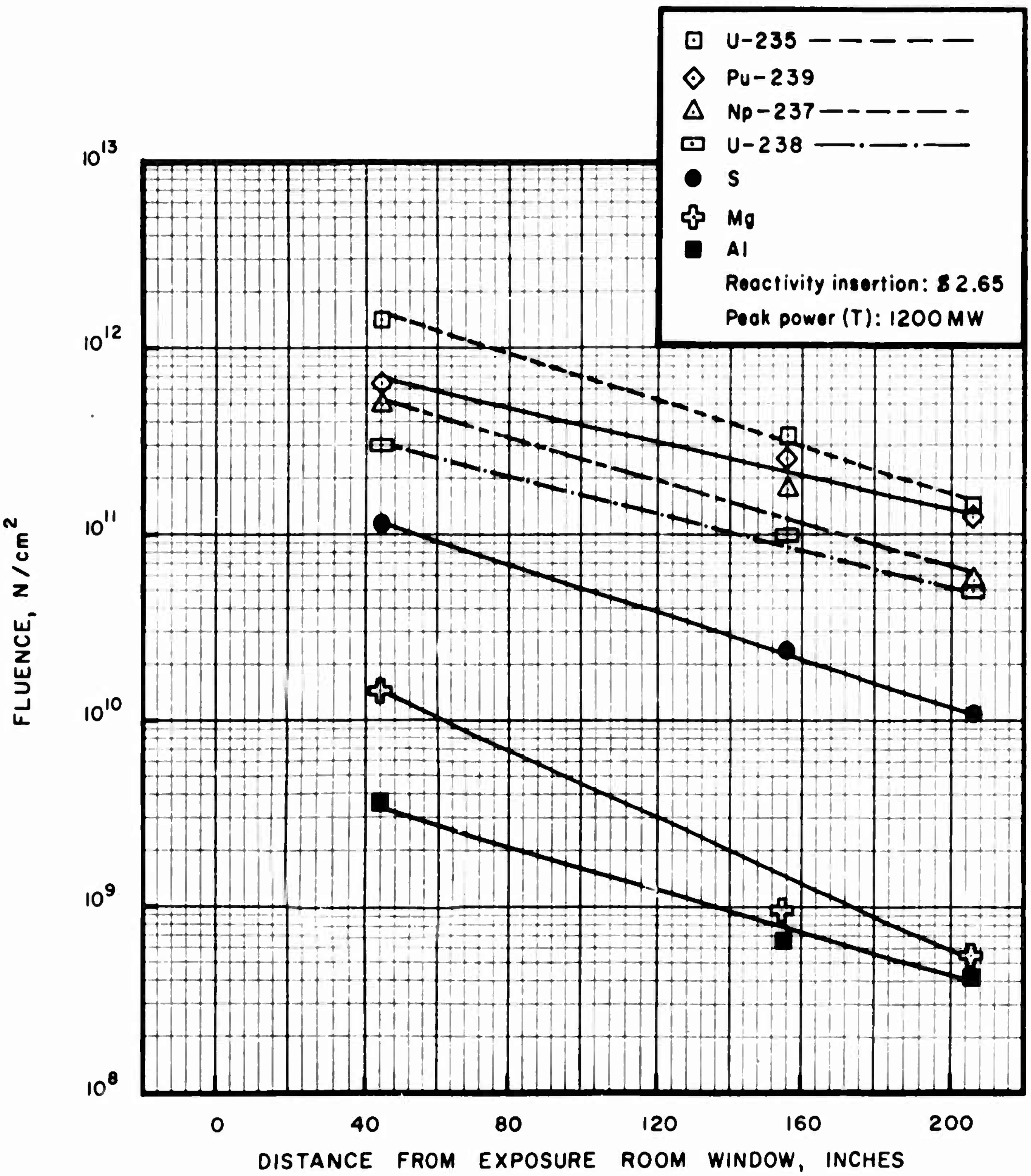


FIGURE 68. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, 15° FROM ROOM MIDLINE (SEE FIGURE 10), 72 INCHES ABOVE THE FLOOR.

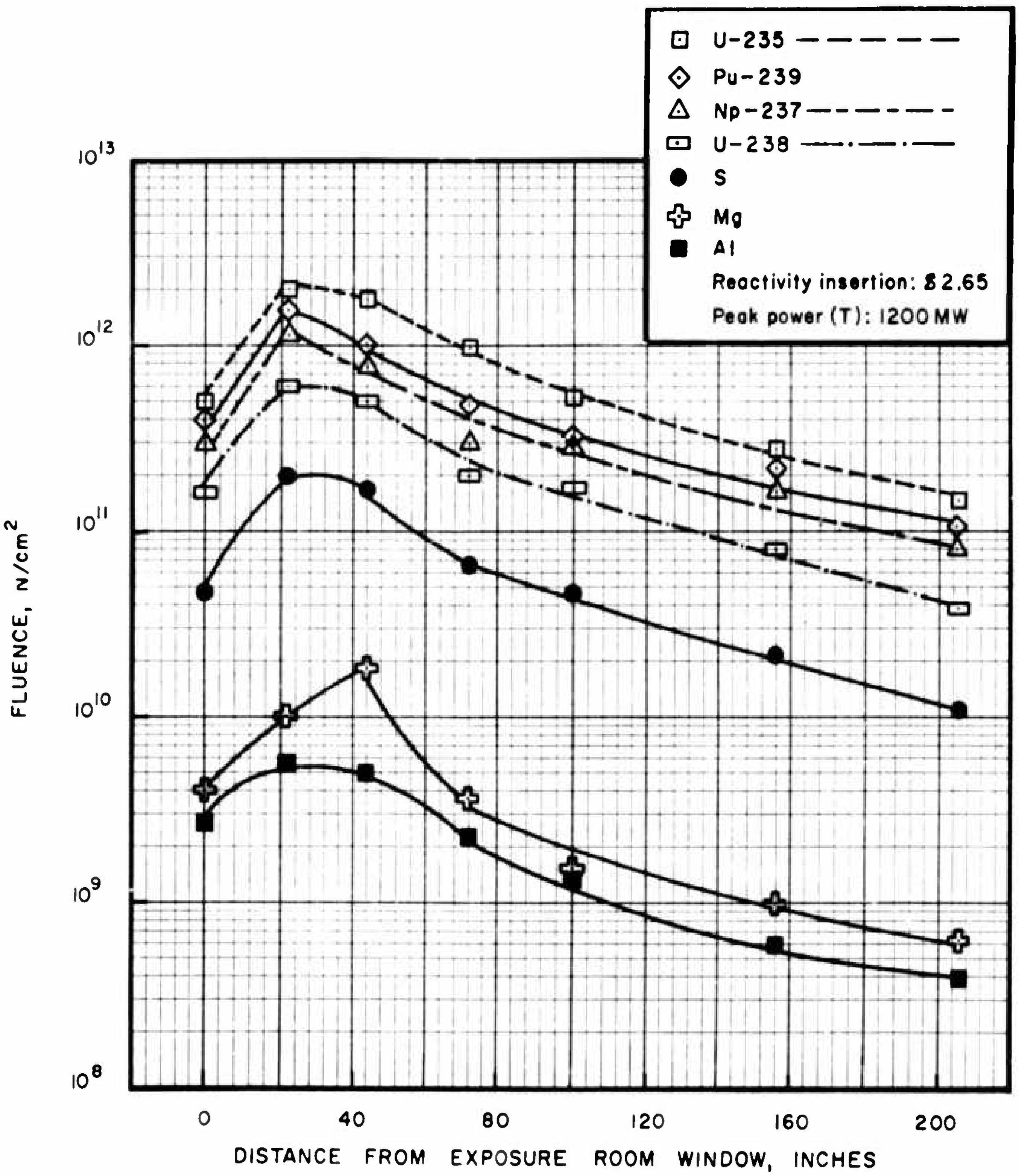


FIGURE 69. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, ALONG ROOM MIDLINE (SEE FIGURE 10), 72 INCHES ABOVE THE FLOOR.

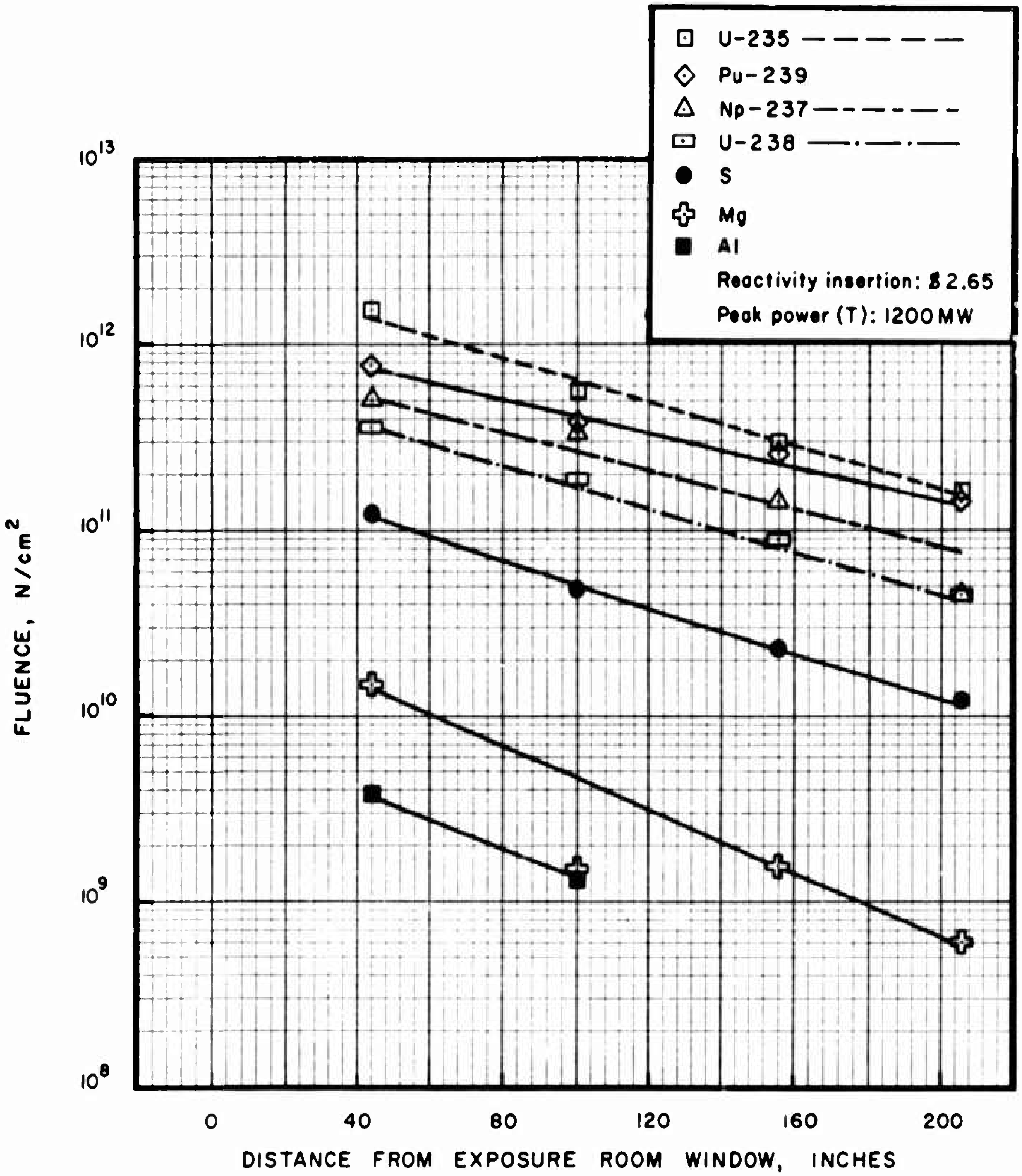


FIGURE 70. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, −15° FROM ROOM MIDLINE (SEE FIGURE 10), 72 INCHES ABOVE THE FLOOR.

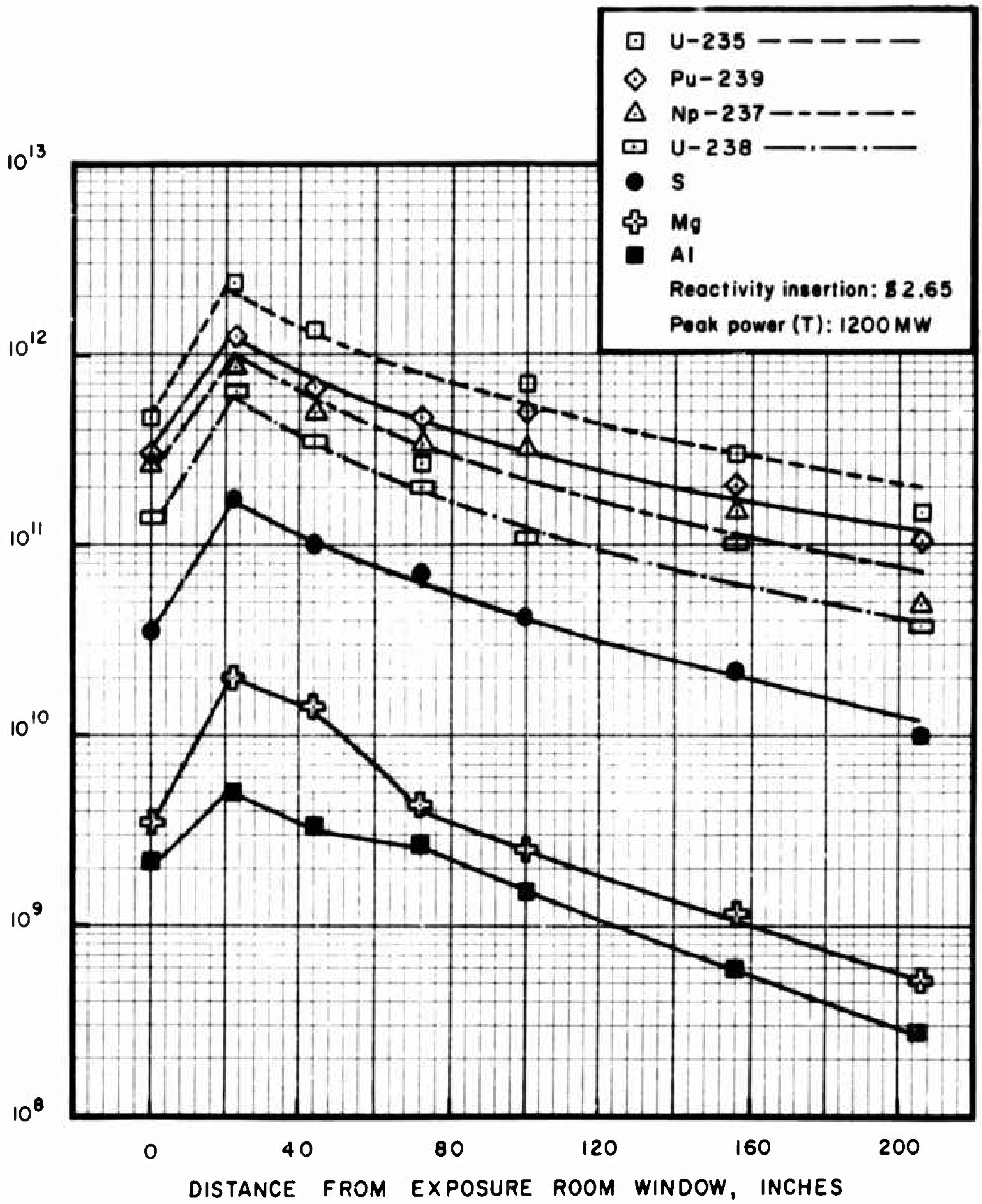


FIGURE 71. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, - 30° FROM ROOM MIDLINE (SEE FIGURE 10), 72 INCHES ABOVE THE FLOOR.

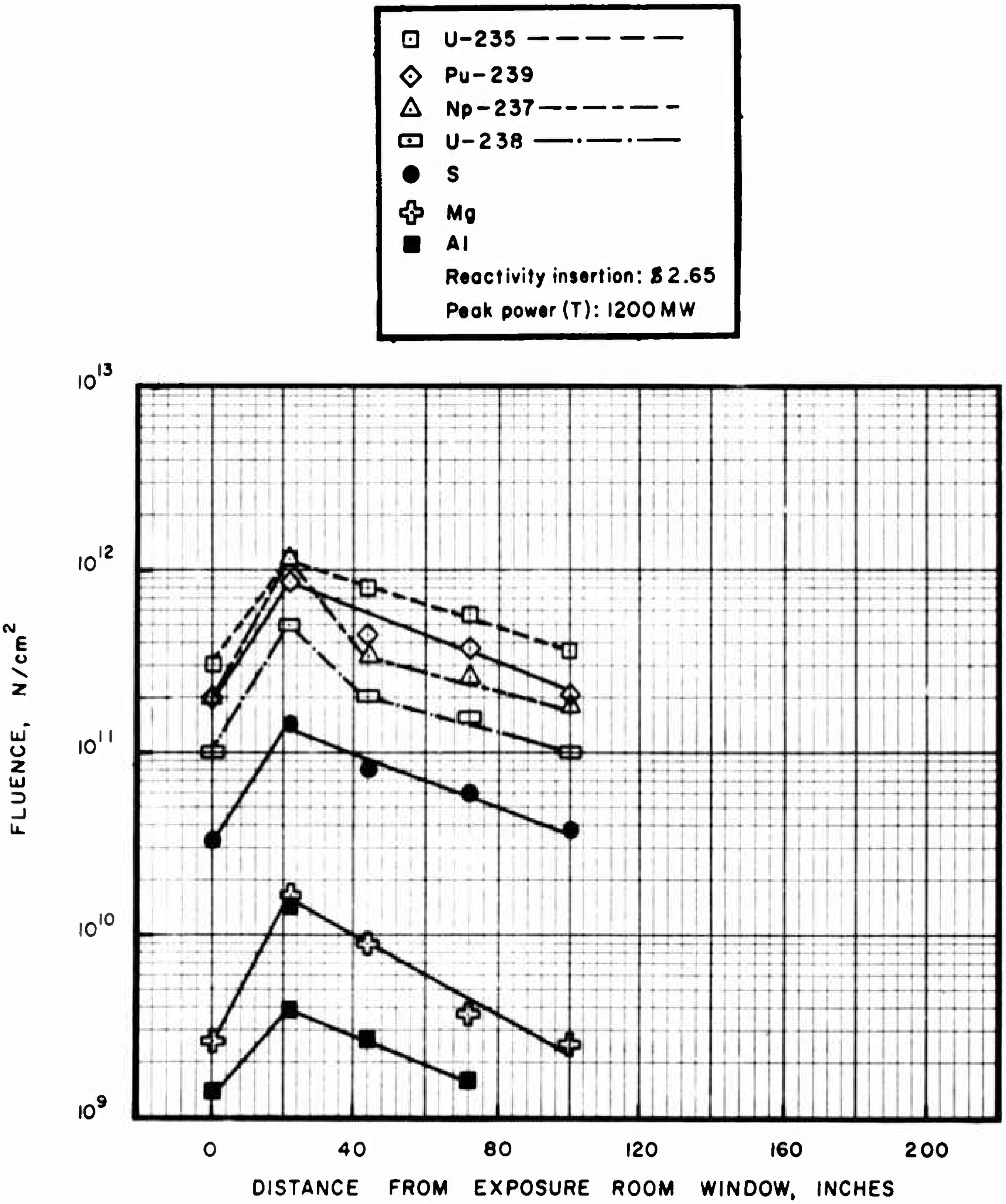


FIGURE 72. EXPOSURE ROOM RADIAL FAST NEUTRON GRADIENT, —60° FROM ROOM MIDLINE (SEE FIGURE 10), 72 INCHES ABOVE THE FLOOR.

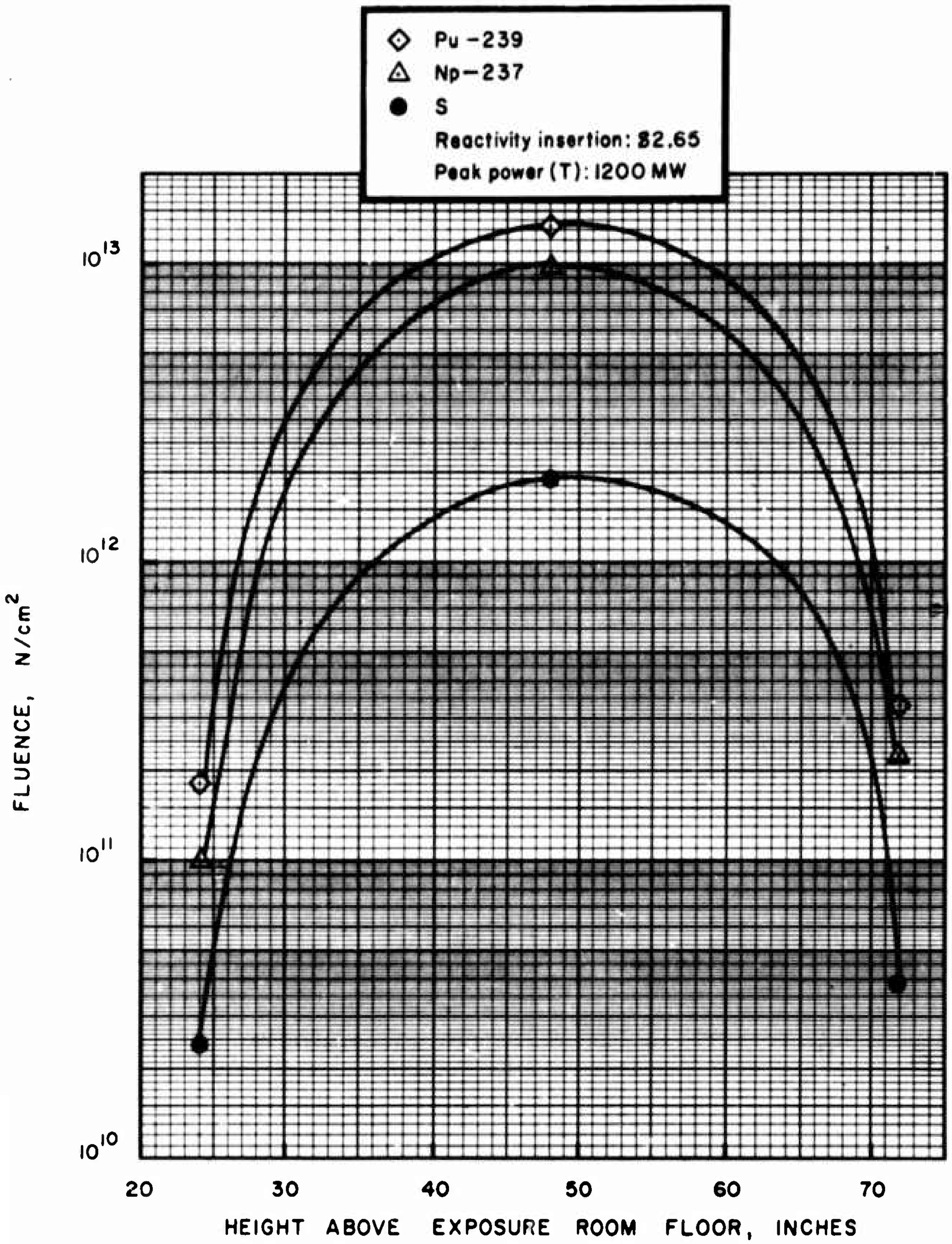


FIGURE 73. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT ADJACENT TO EXPOSURE ROOM WINDOW, 90° FROM ROOM MIDLINE (SEE FIGURE 10).

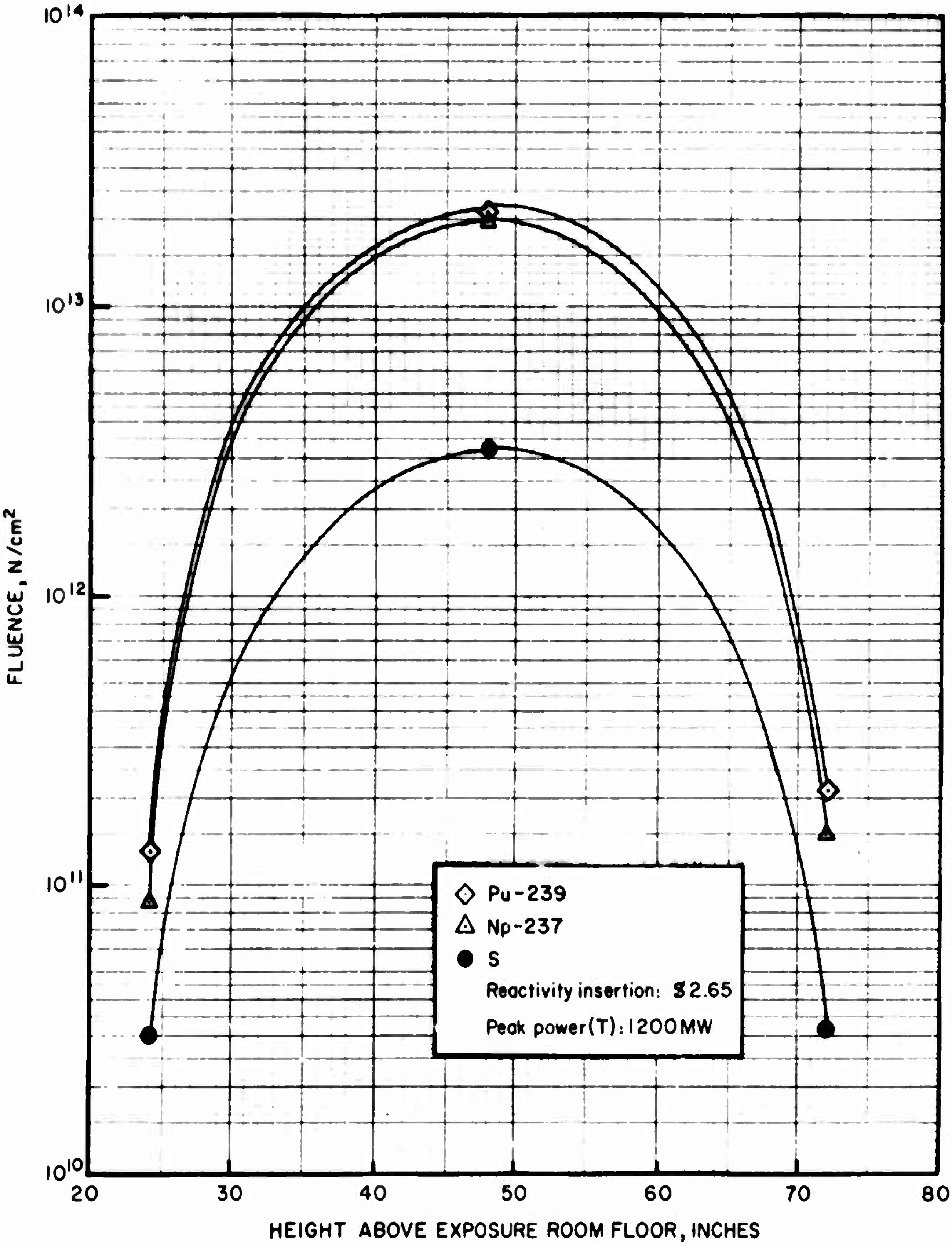


FIGURE 74. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT ADJACENT TO EXPOSURE ROOM WINDOW, 60° FROM ROOM MIDLINE. (SEE FIGURE 10)

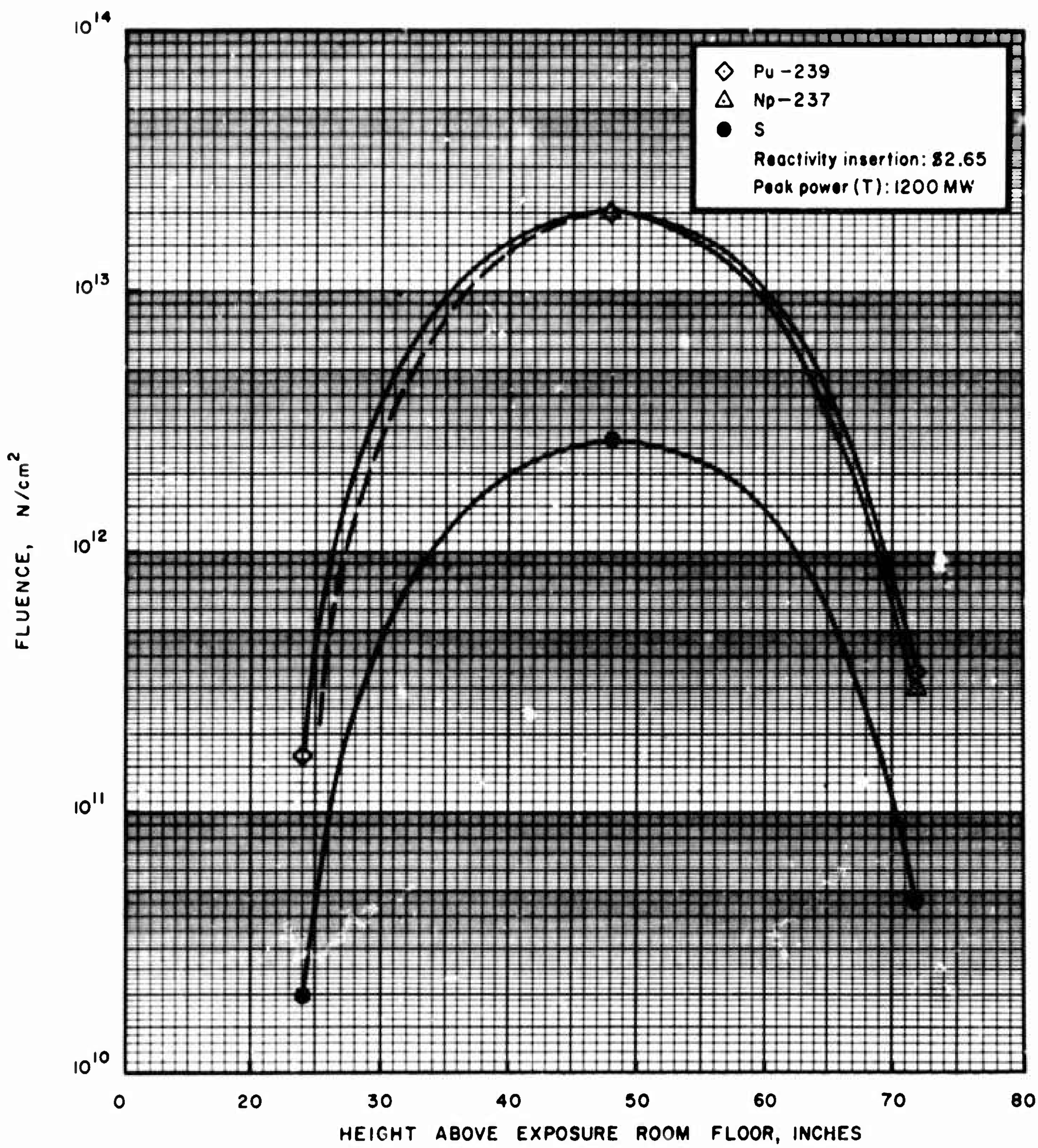


FIGURE 75. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT ADJACENT TO EXPOSURE ROOM WINDOW, 30° FROM ROOM MIDLINE (SEE FIGURE 10).

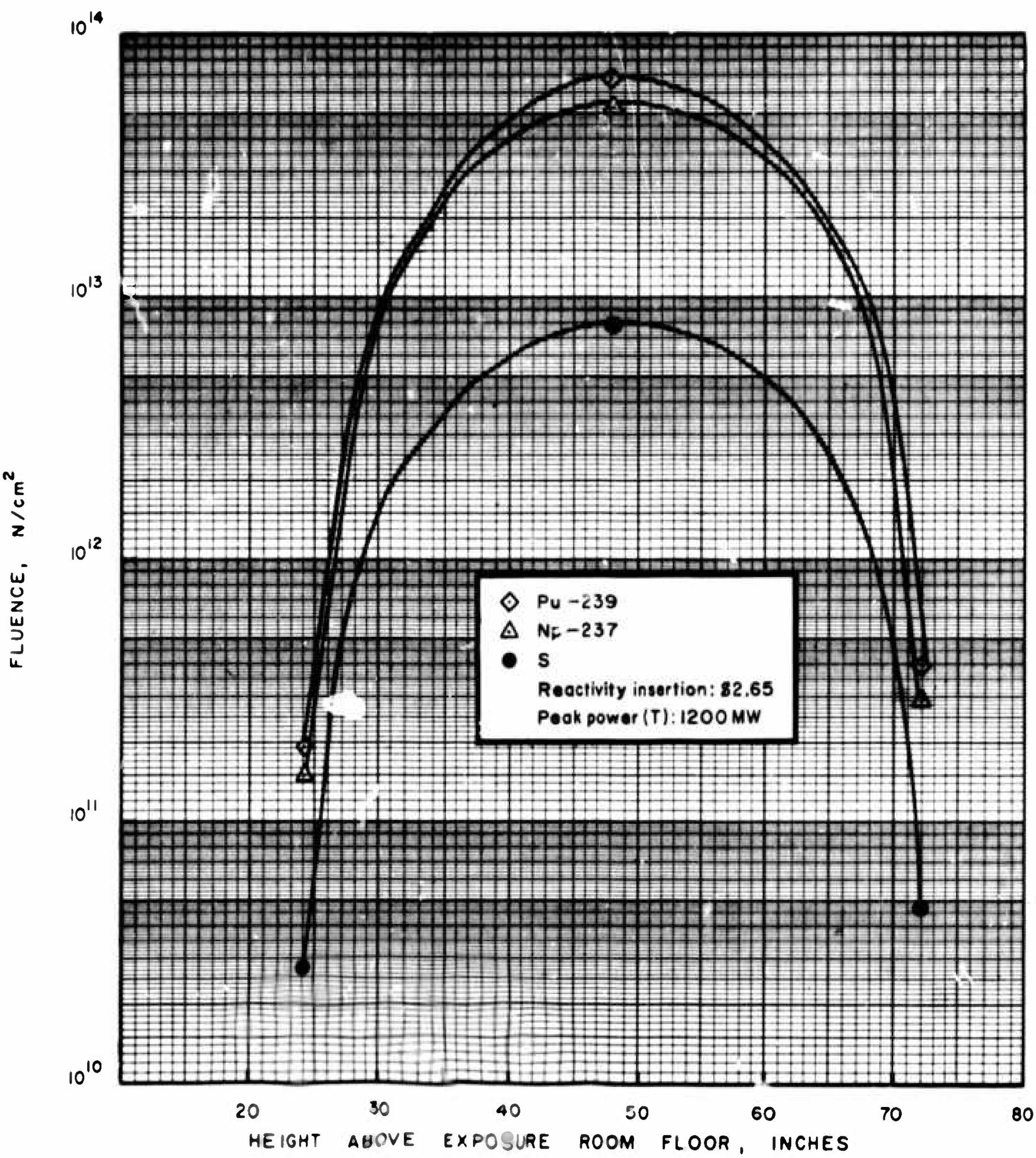


FIGURE 76. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT ADJACENT TO EXPOSURE ROOM WINDOW, ON ROOM MIDLINE (SEE FIGURE 10).

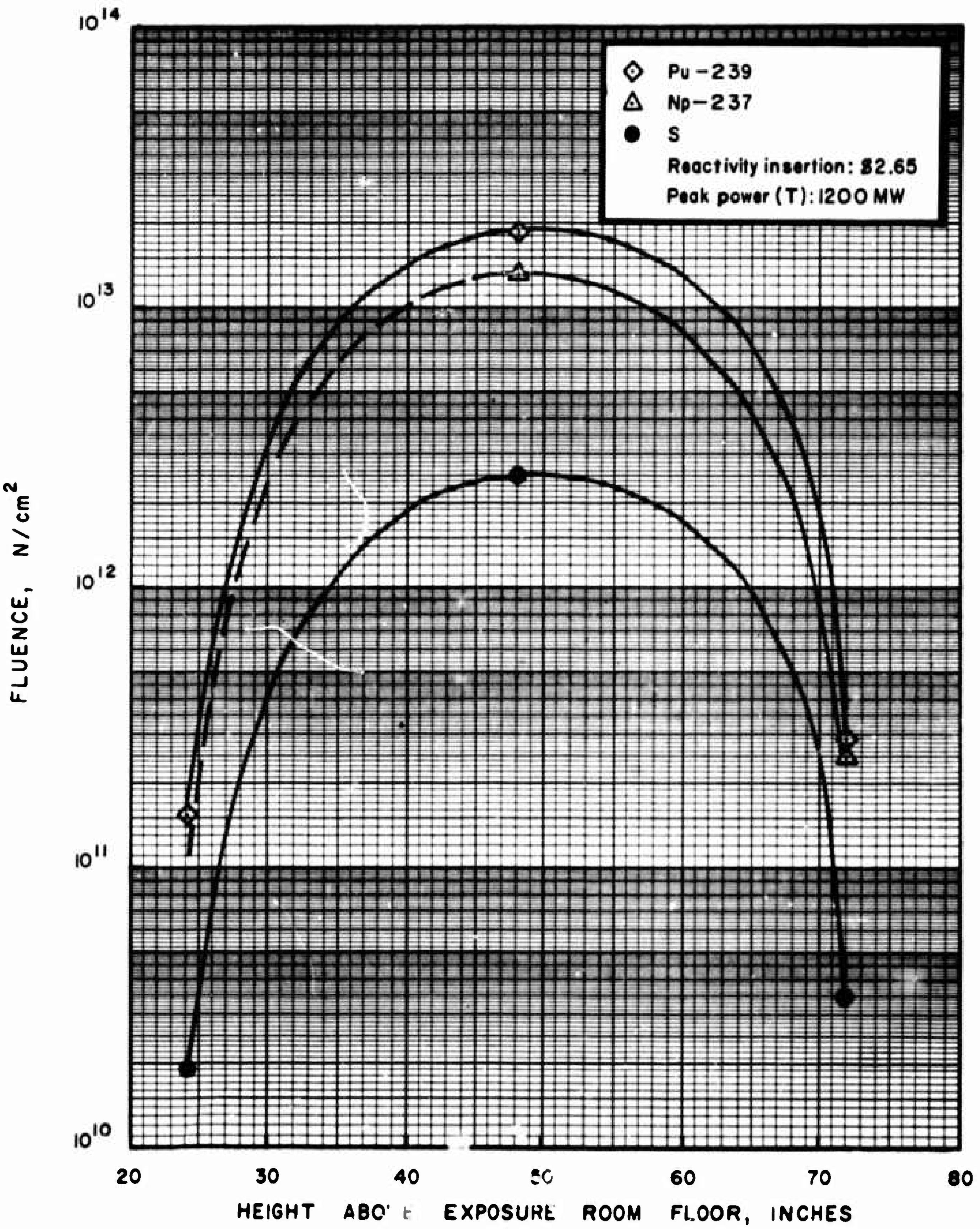


FIGURE 77. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT ADJACENT TO EXPOSURE ROOM WINDOW, -30° FROM ROOM MIDLINE (SEE FIGURE 10).

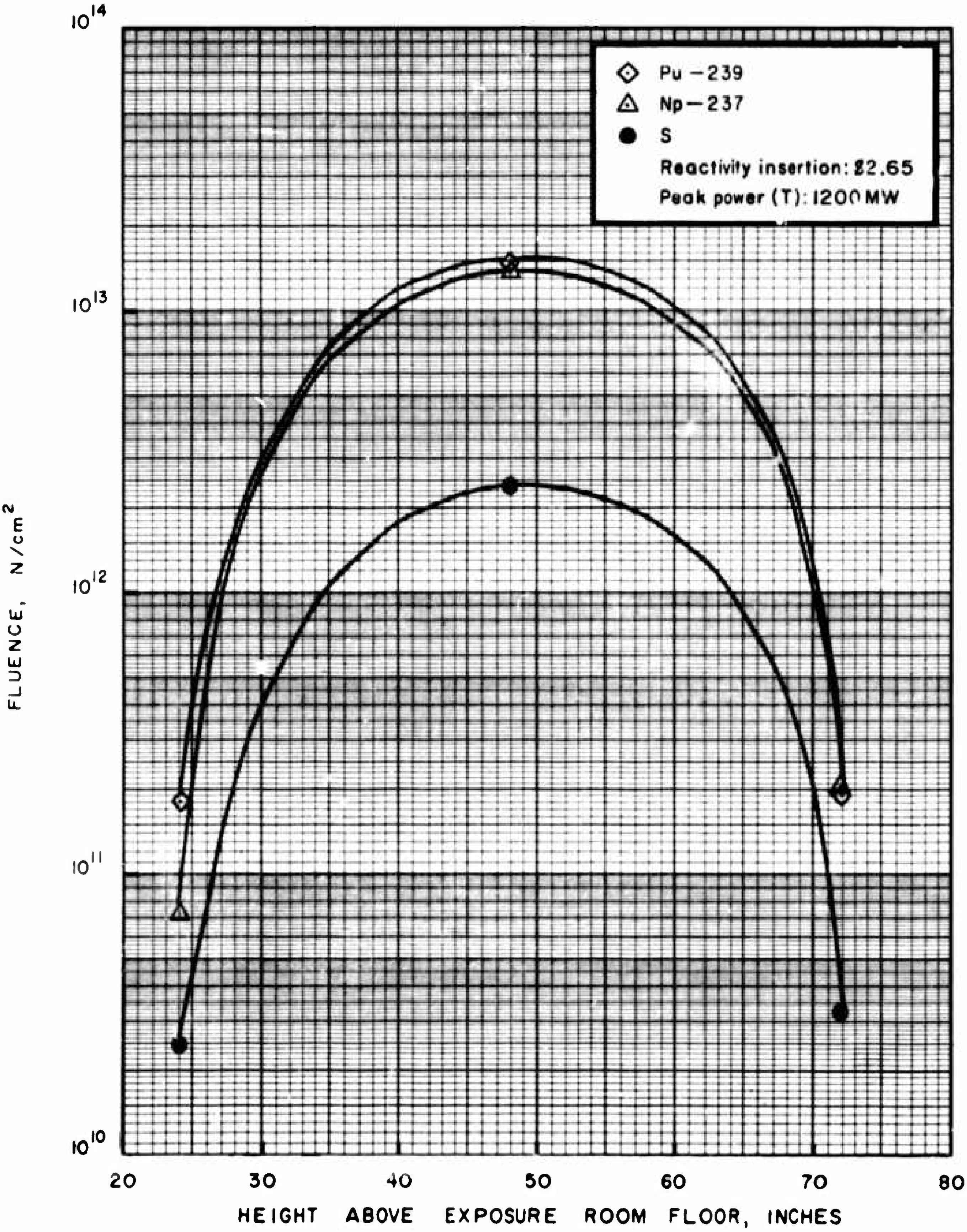


FIGURE 78. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT ADJACENT TO EXPOSURE ROOM WINDOW, -60° FROM ROOM MIDLINE (SEE FIGURE 10).

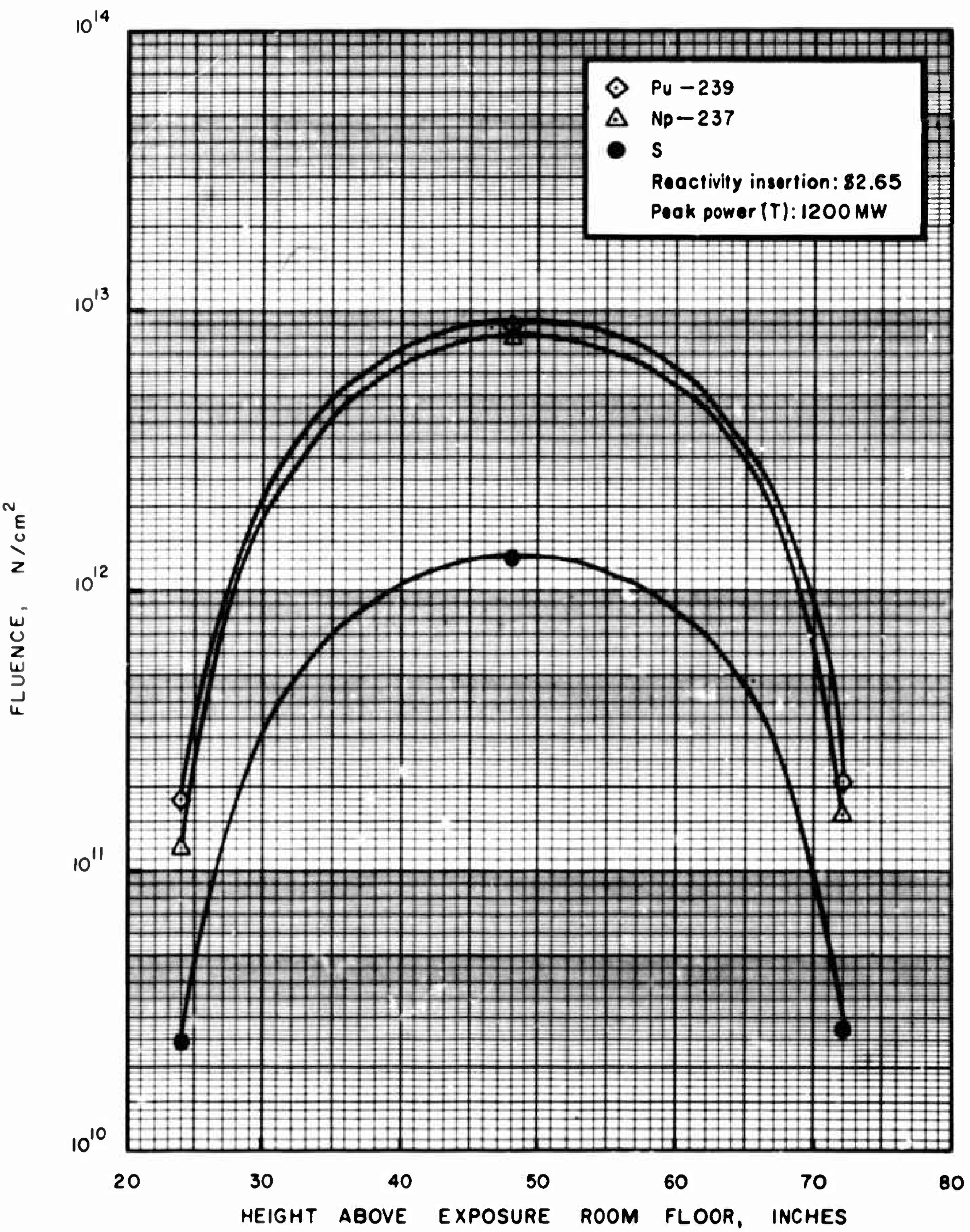


FIGURE 79. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT ADJACENT TO EXPOSURE ROOM WINDOW, — 90° FROM ROOM MIDLINE (SEE FIGURE 10).

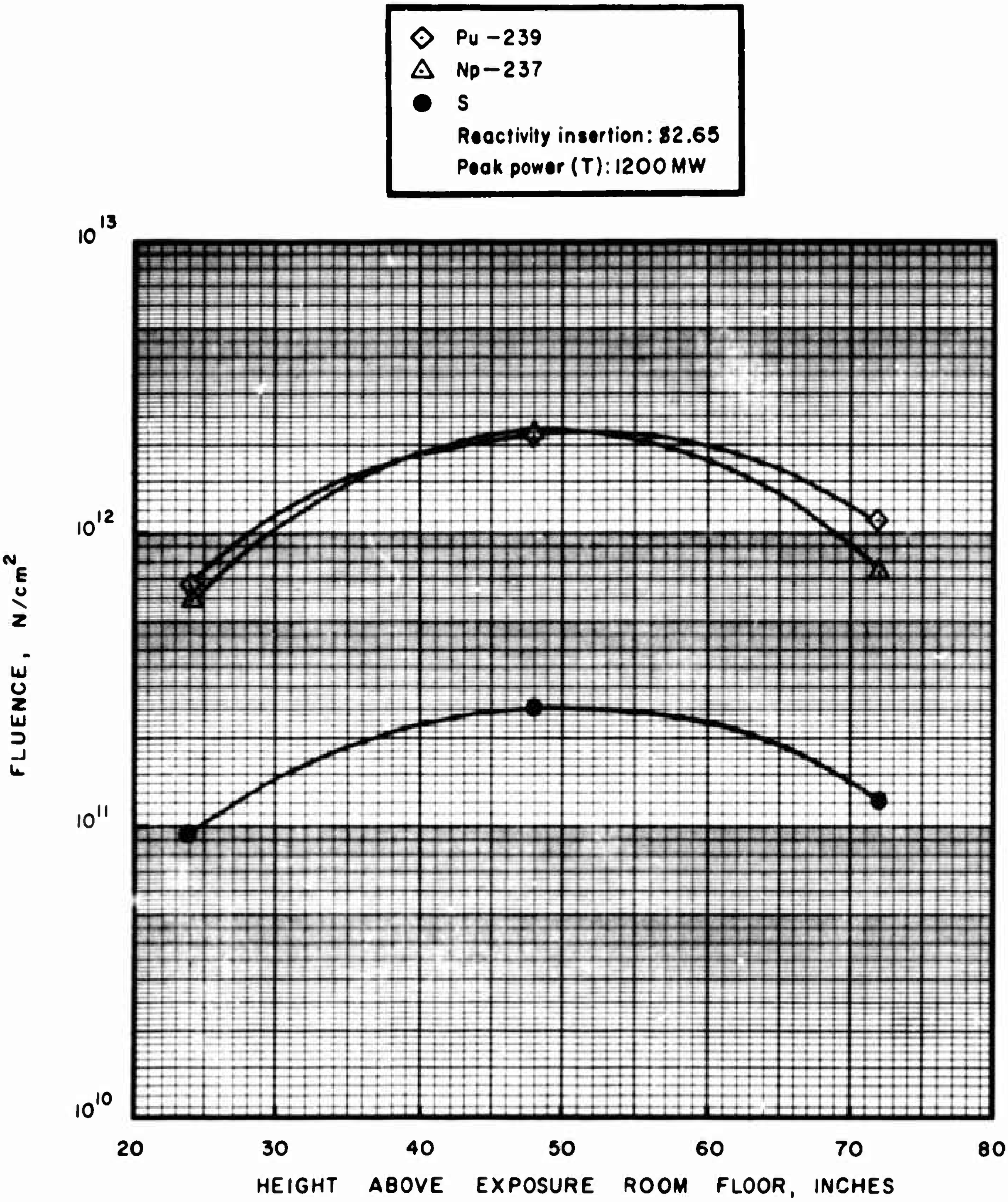


FIGURE 80. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 22 INCHES FROM EXPOSURE ROOM WINDOW, 90° FROM ROOM MIDLINE (SEE FIGURE 10).

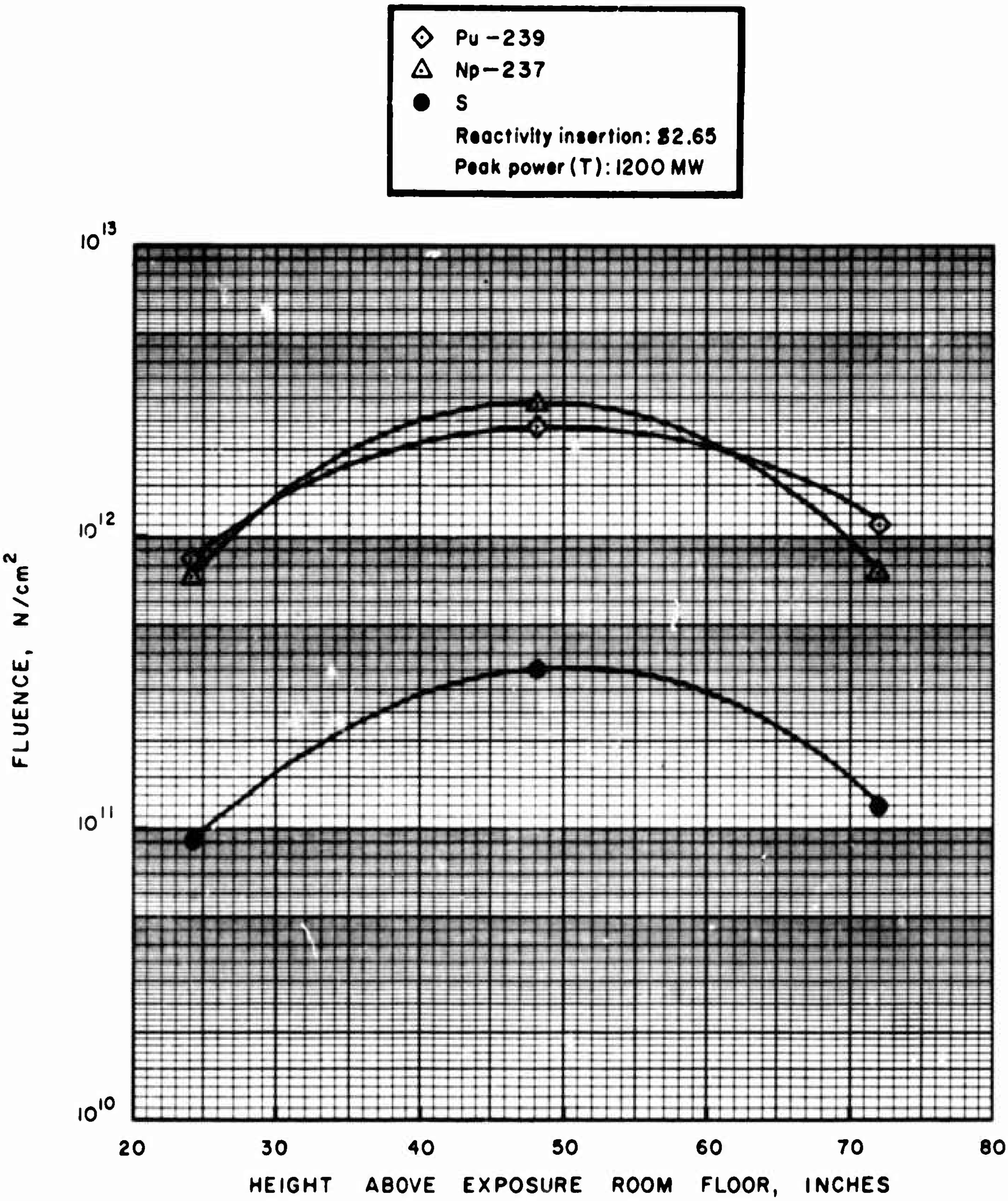


FIGURE 81. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 22 INCHES FROM EXPOSURE ROOM WINDOW, 60° FROM ROOM MIDLINE (SEE FIGURE 10).

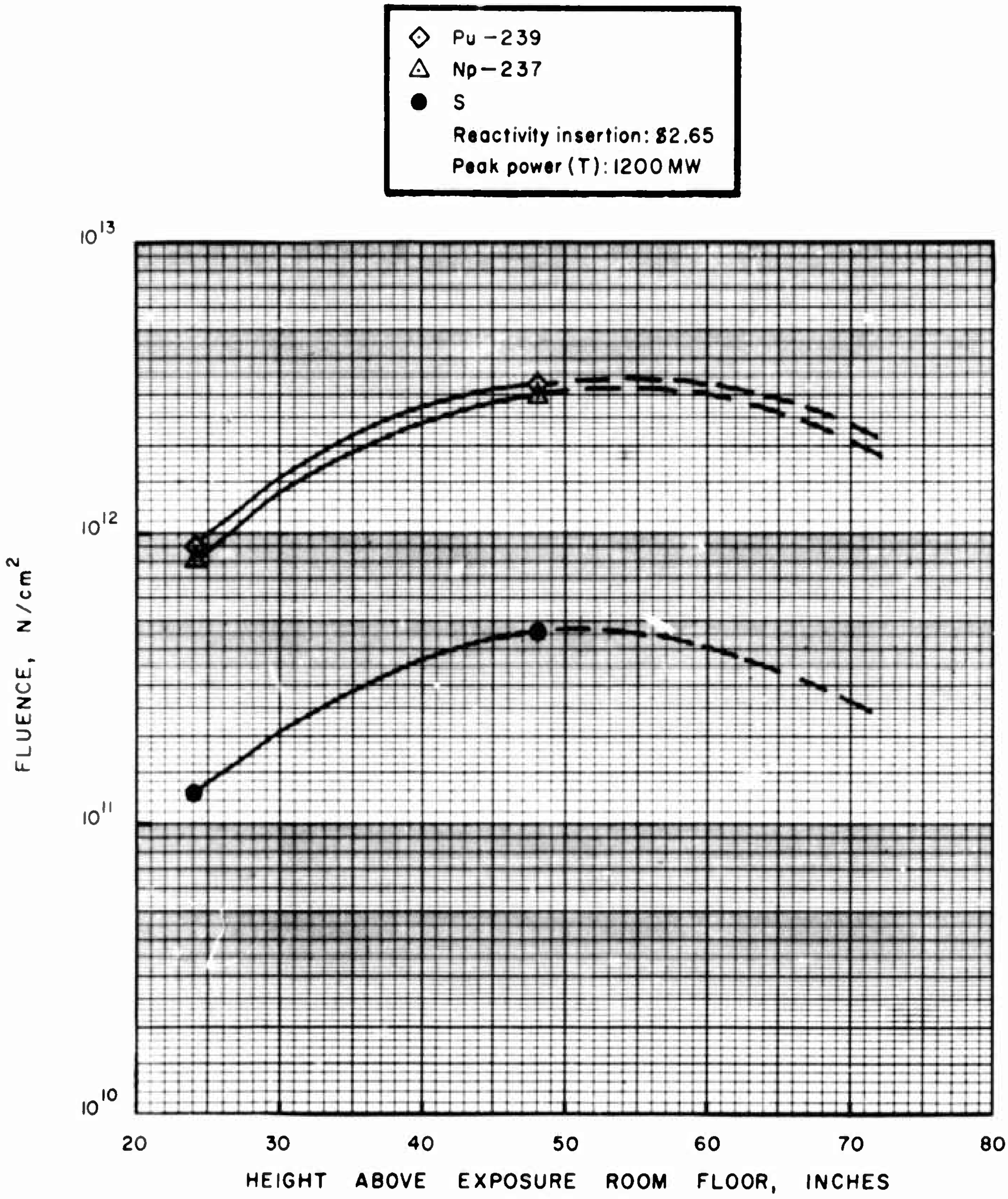


FIGURE 82. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 22 INCHES FROM EXPOSURE ROOM WINDOW, 30° FROM ROOM MIDLINE (SEE FIGURE 10).

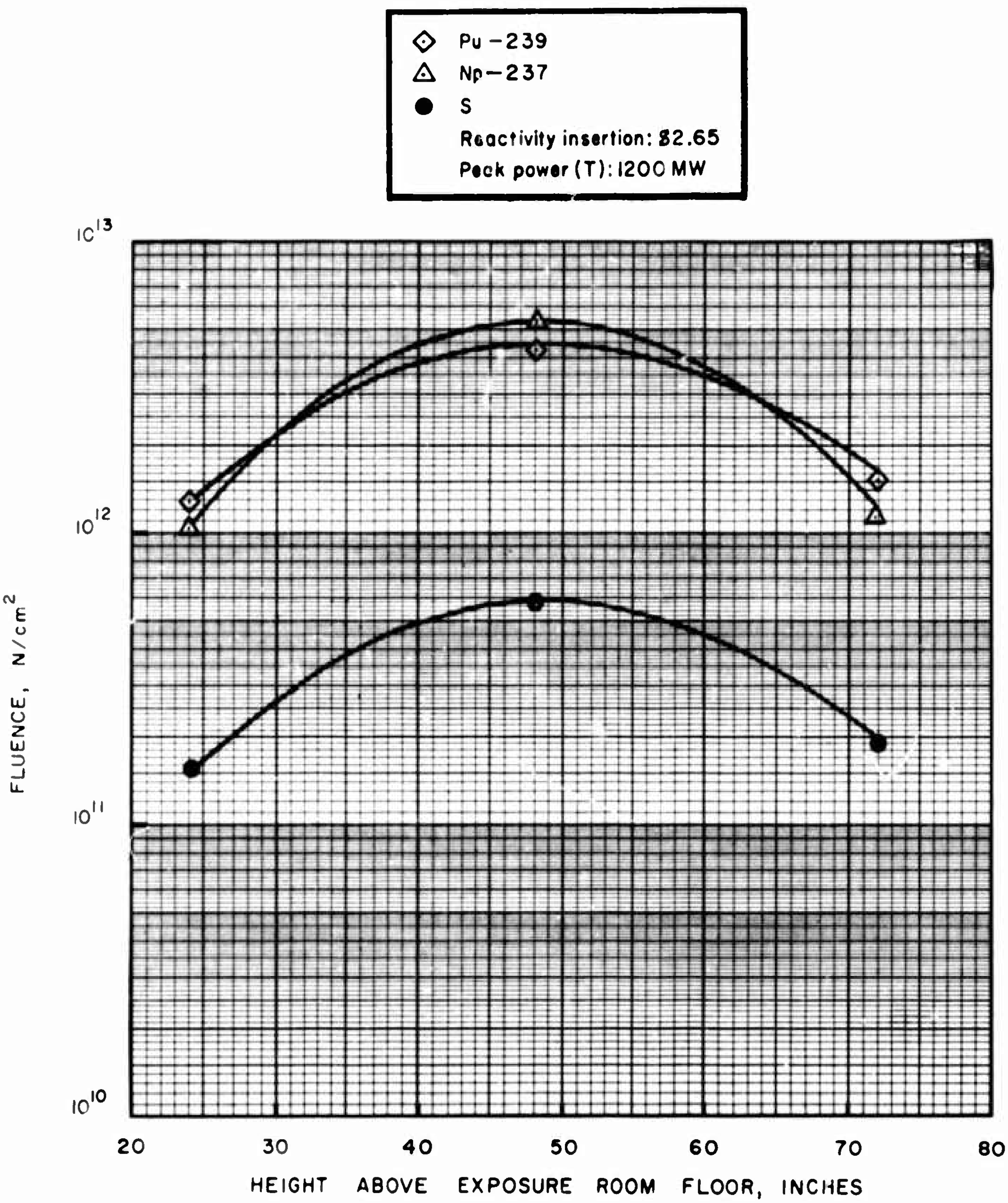


FIGURE 83. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 22 INCHES FROM EXPOSURE ROOM WINDOW, ON ROOM MIDLINE (SEE FIGURE 10).

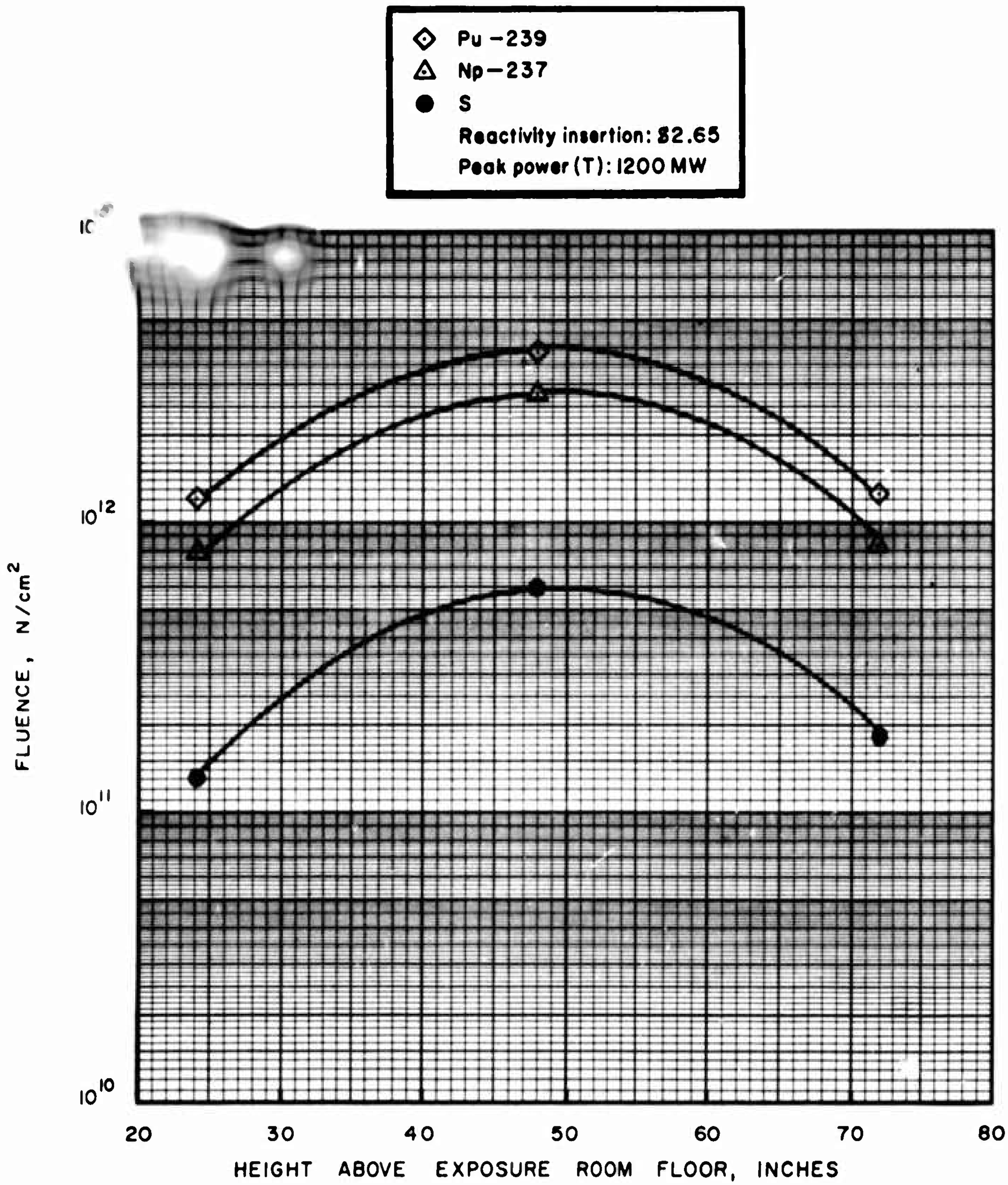


FIGURE 84. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 22 INCHES FROM EXPOSURE ROOM WINDOW, −30° FROM ROOM MIDLINE (SEE FIGURE 10).

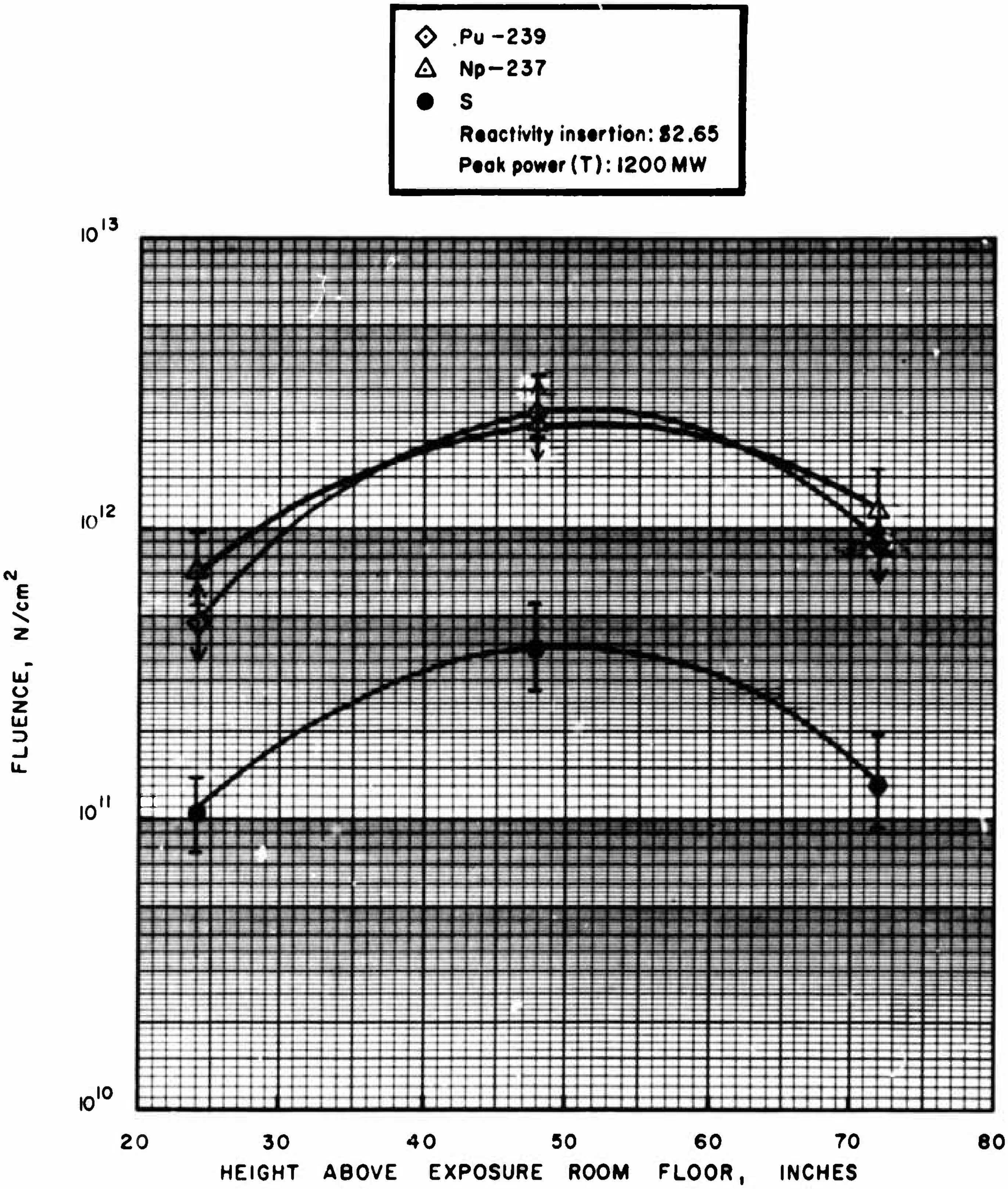


FIGURE 85. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 22 INCHES FROM EXPOSURE ROOM WINDOW, −60° FROM ROOM MIDLINE (SEE FIGURE 10).

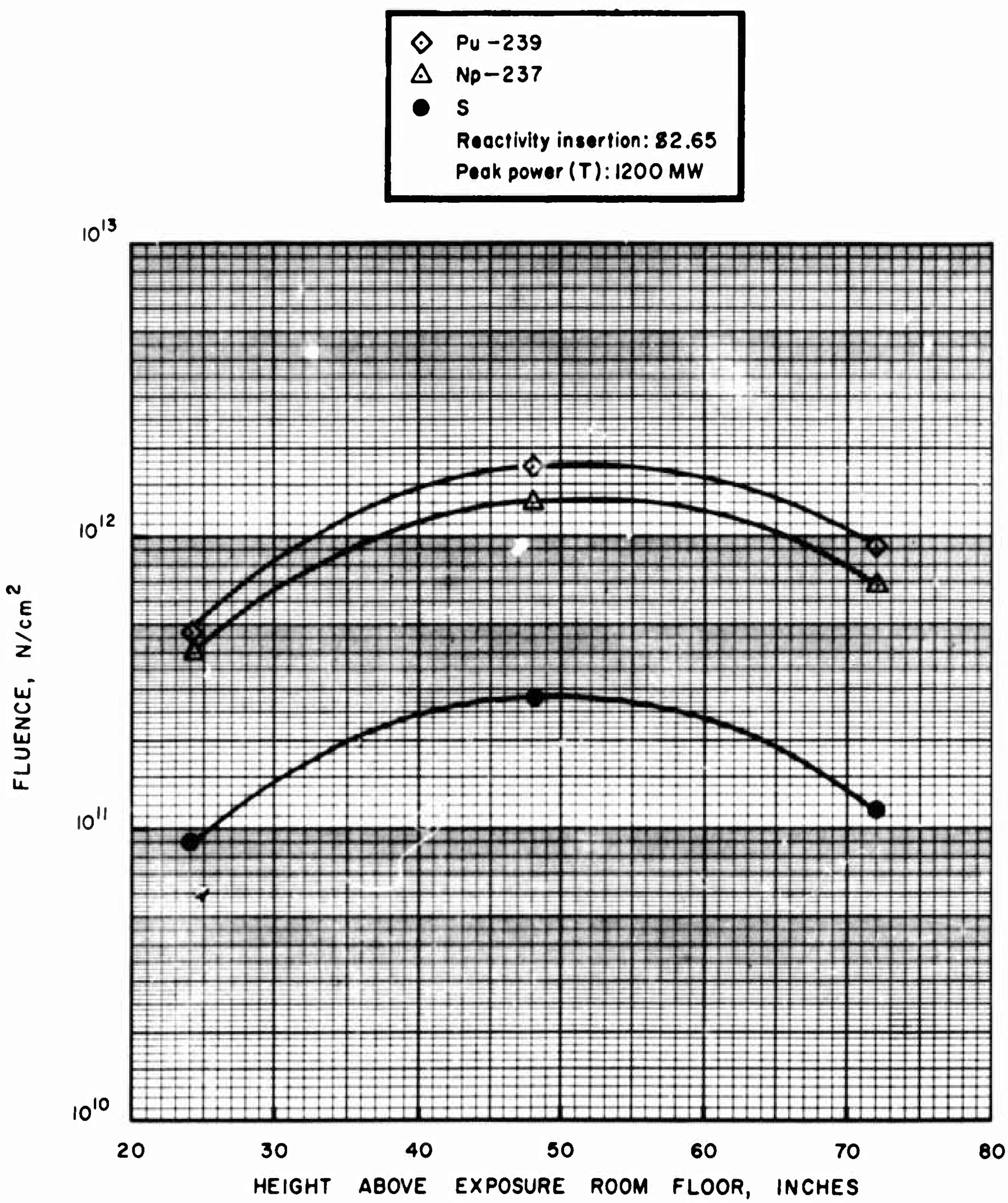


FIGURE 86. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 22 INCHES FROM EXPOSURE ROOM WINDOW, -90° FROM ROOM MIDLINE (SEE FIGURE 10).

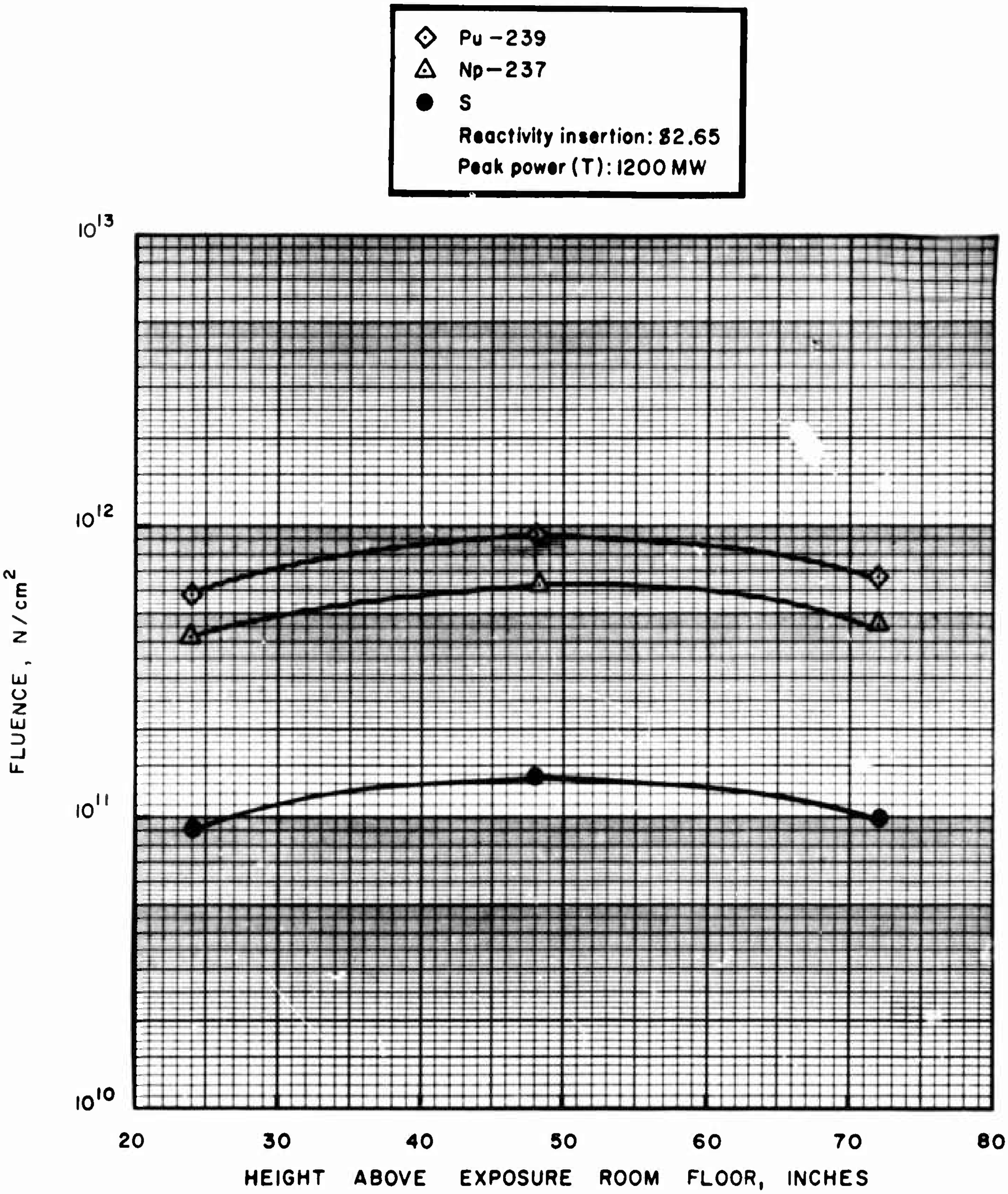


FIGURE 87. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 44 INCHES FROM EXPOSURE ROOM WINDOW, 60° FROM ROOM MIDLINE (SEE FIGURE 10).

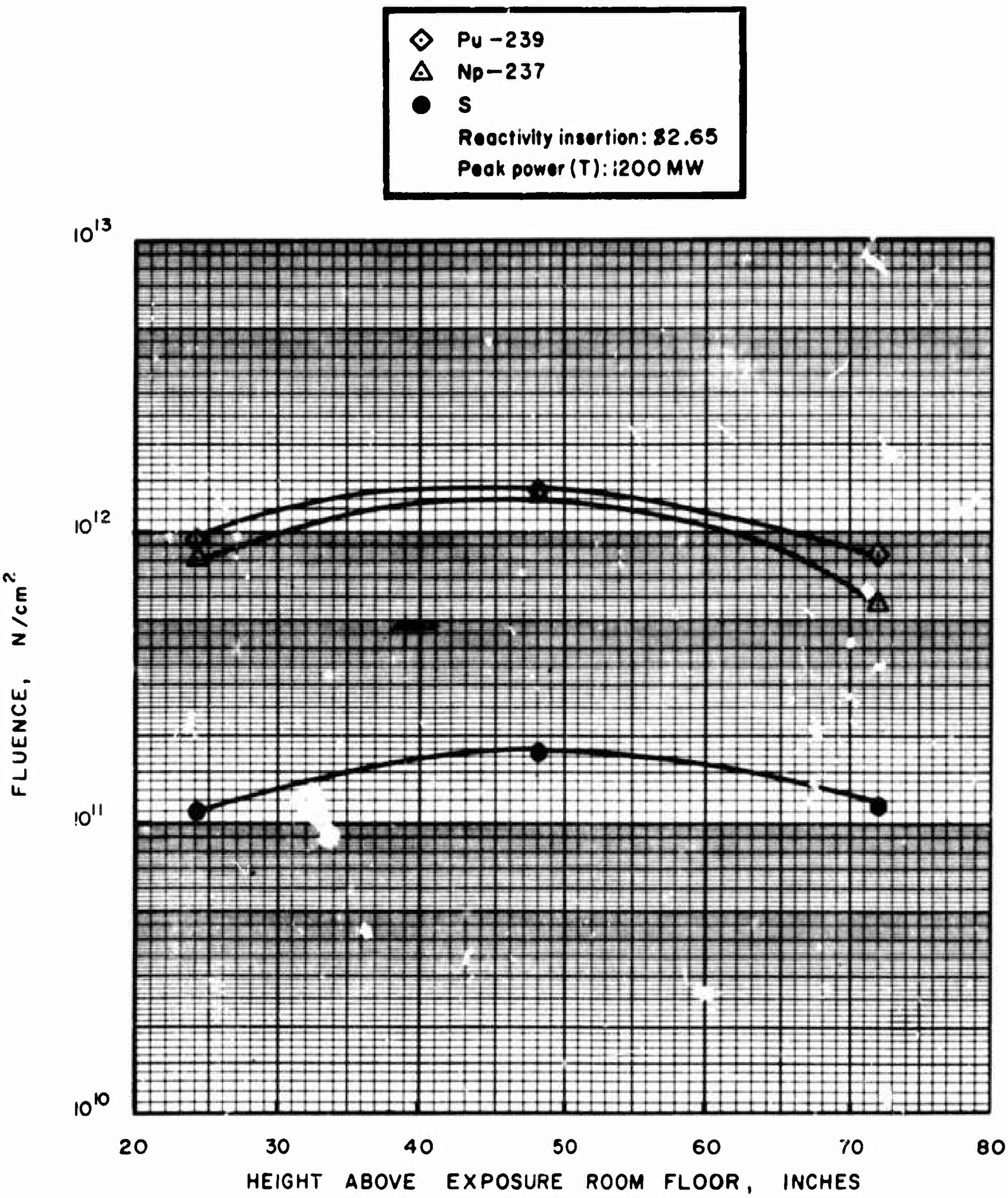


FIGURE 88. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 44 INCHES FROM EXPOSURE ROOM WINDOW, 30° FROM ROOM MIDLINE (SEE FIGURE 10).

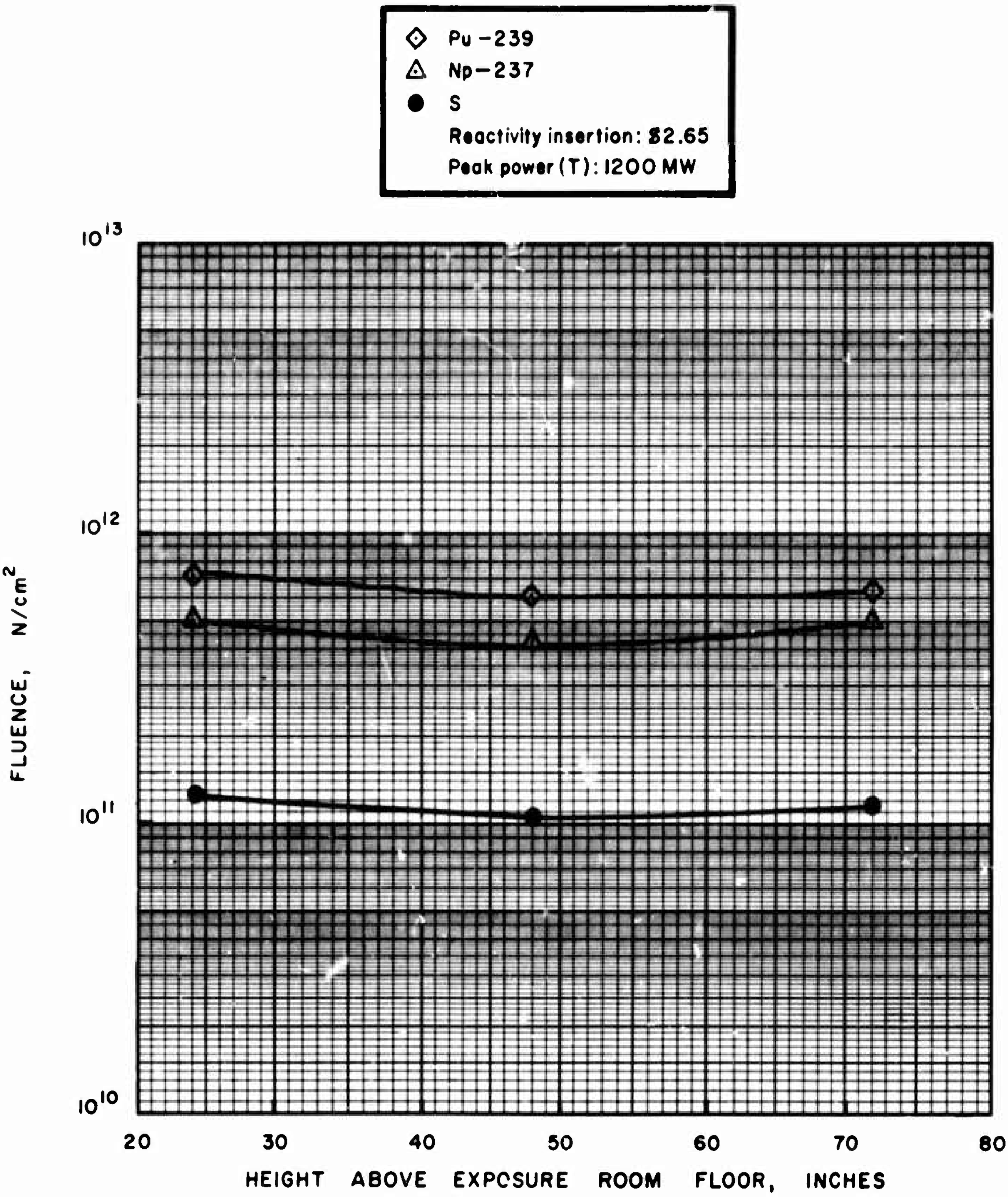


FIGURE 89. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 44 INCHES FROM EXPOSURE ROOM WINDOW, 15° FROM ROOM MIDLINE (SEE FIGURE 10).

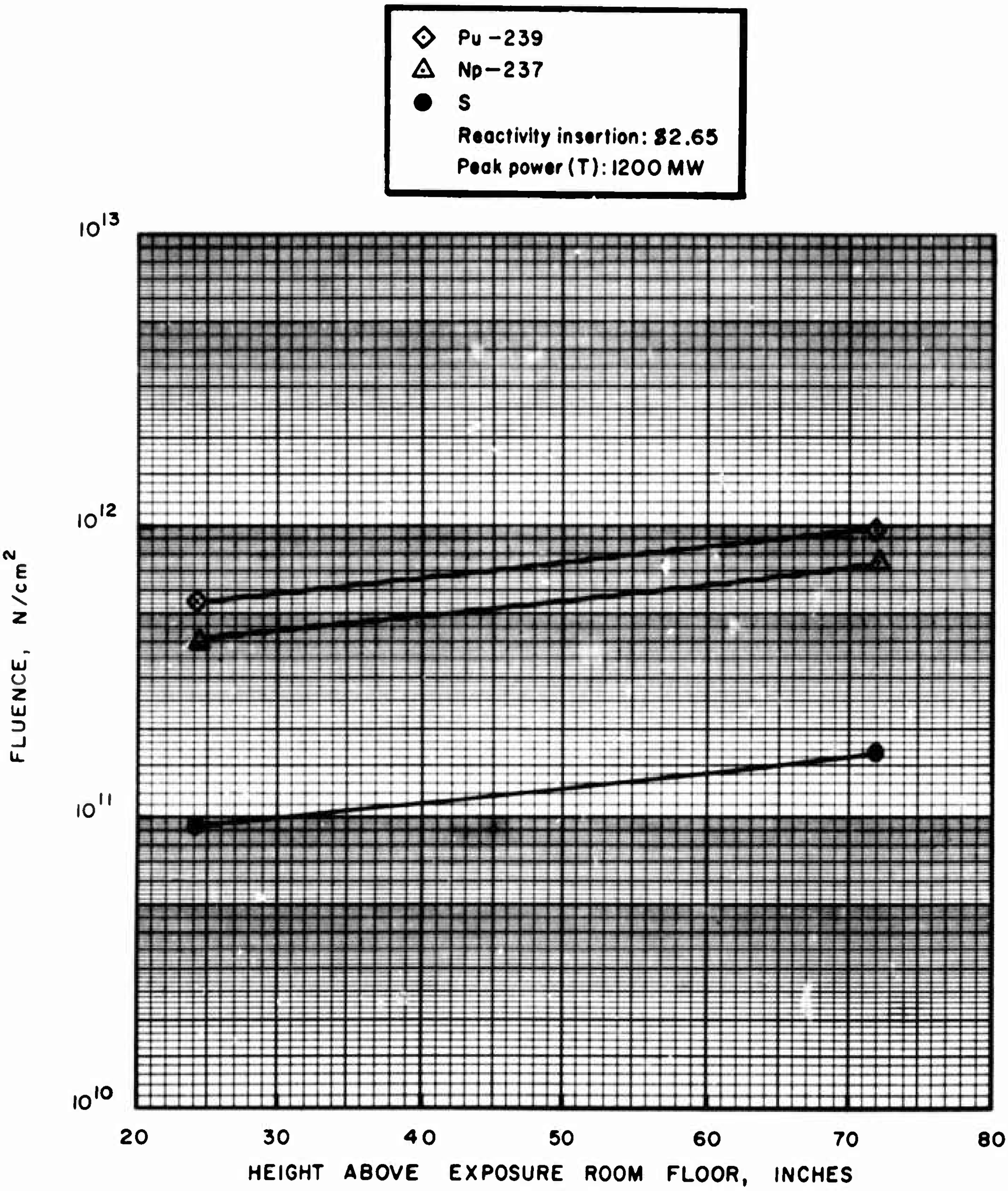


FIGURE 90. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 44 INCHES FROM EXPOSURE ROOM WINDOW, ON ROOM MIDLINE (SEE FIGURE 10).

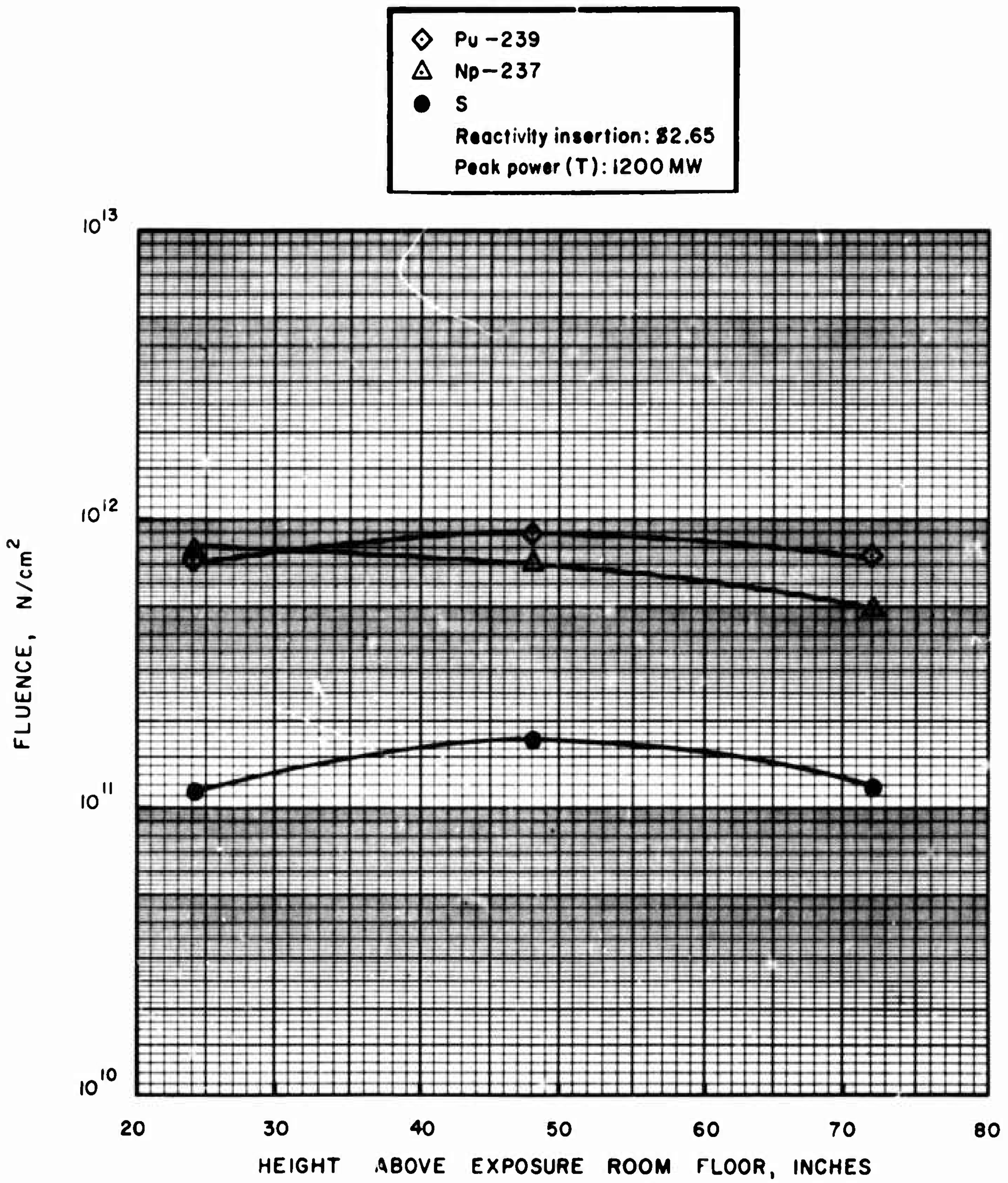


FIGURE 91. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 44 INCHES FROM EXPOSURE ROOM WINDOW, -15° FROM ROOM MIDLINE (SEE FIGURE 10).

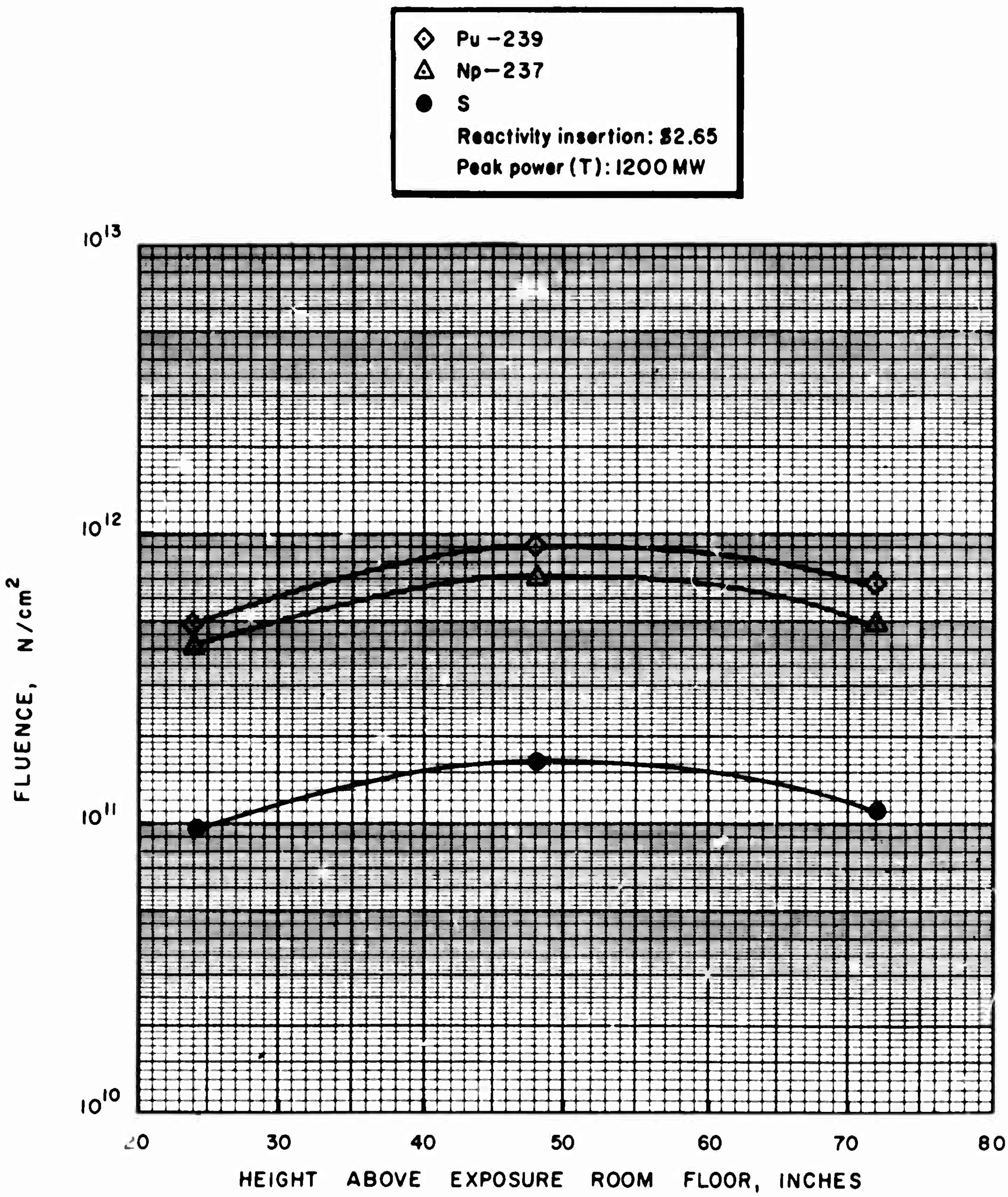


FIGURE 92. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 44 INCHES FROM EXPOSURE ROOM WINDOW, - 30° FROM ROOM MIDLINE (SEE FIGURE 10).

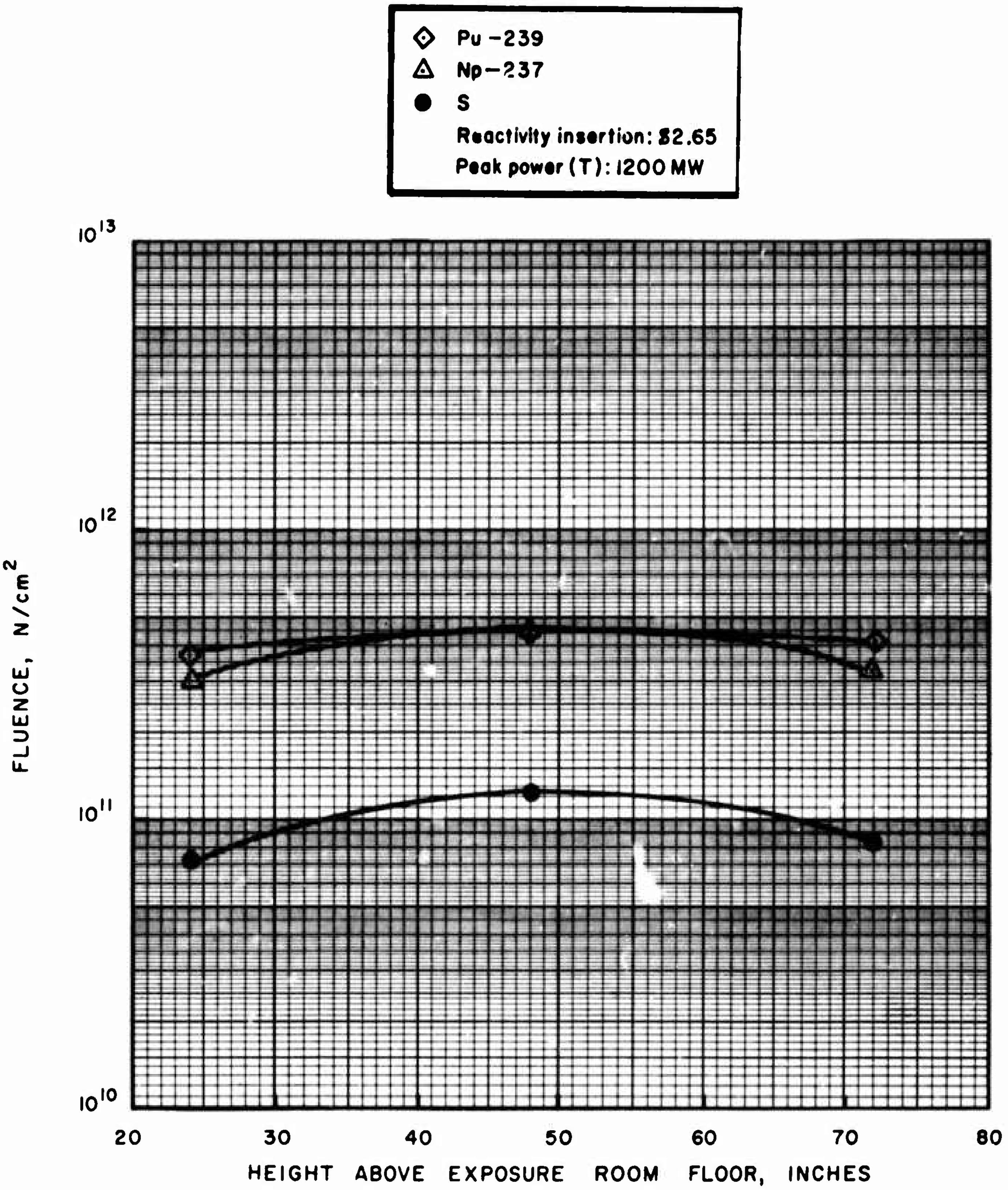


FIGURE 93. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 44 INCHES FROM EXPOSURE ROOM WINDOW, -60° FROM ROOM MIDLINE (SEE FIGURE 10).

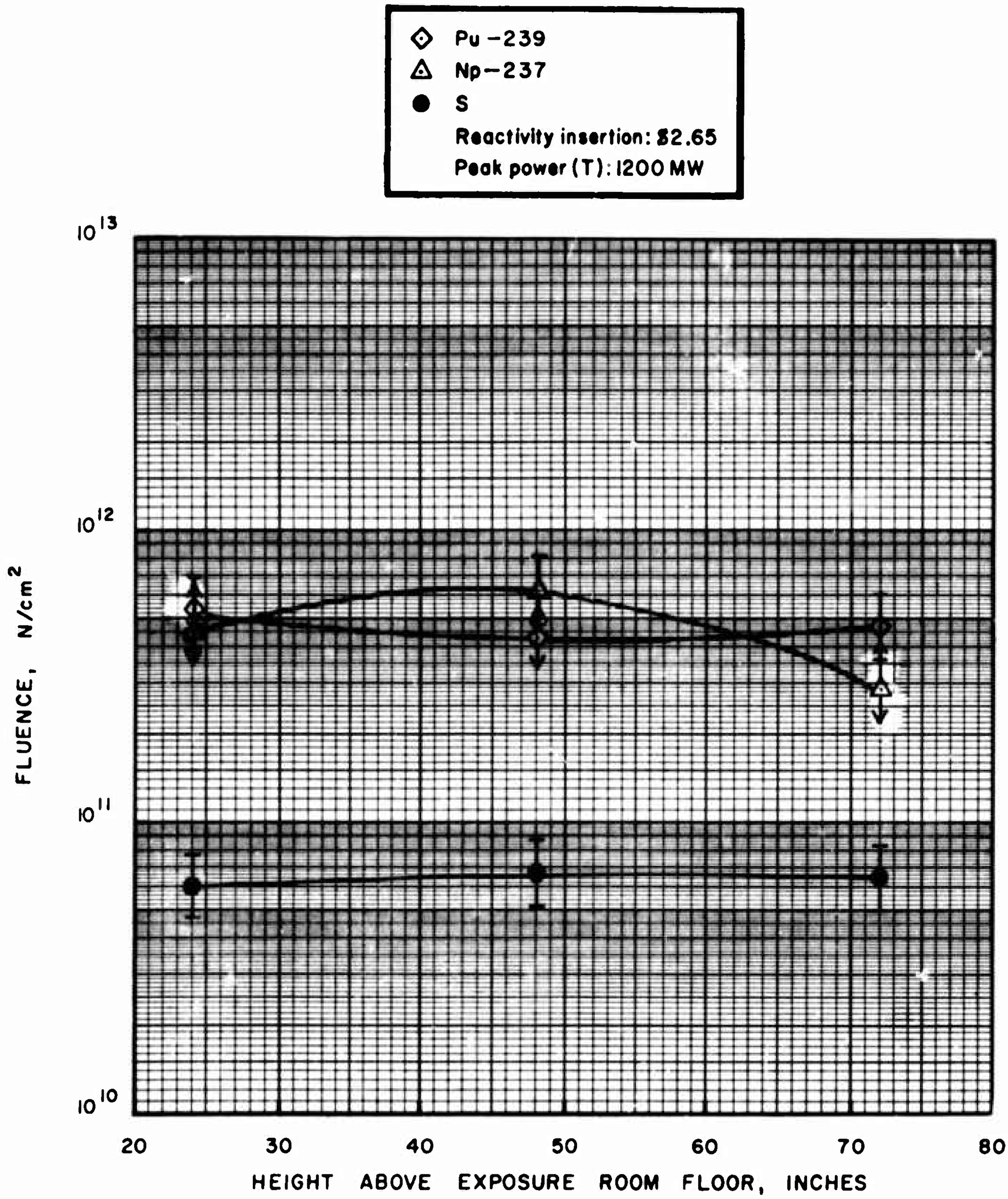


FIGURE 94. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 72 INCHES FROM EXPOSURE ROOM WINDOW, ON ROOM MIDLINE (SEE FIGURE 10).

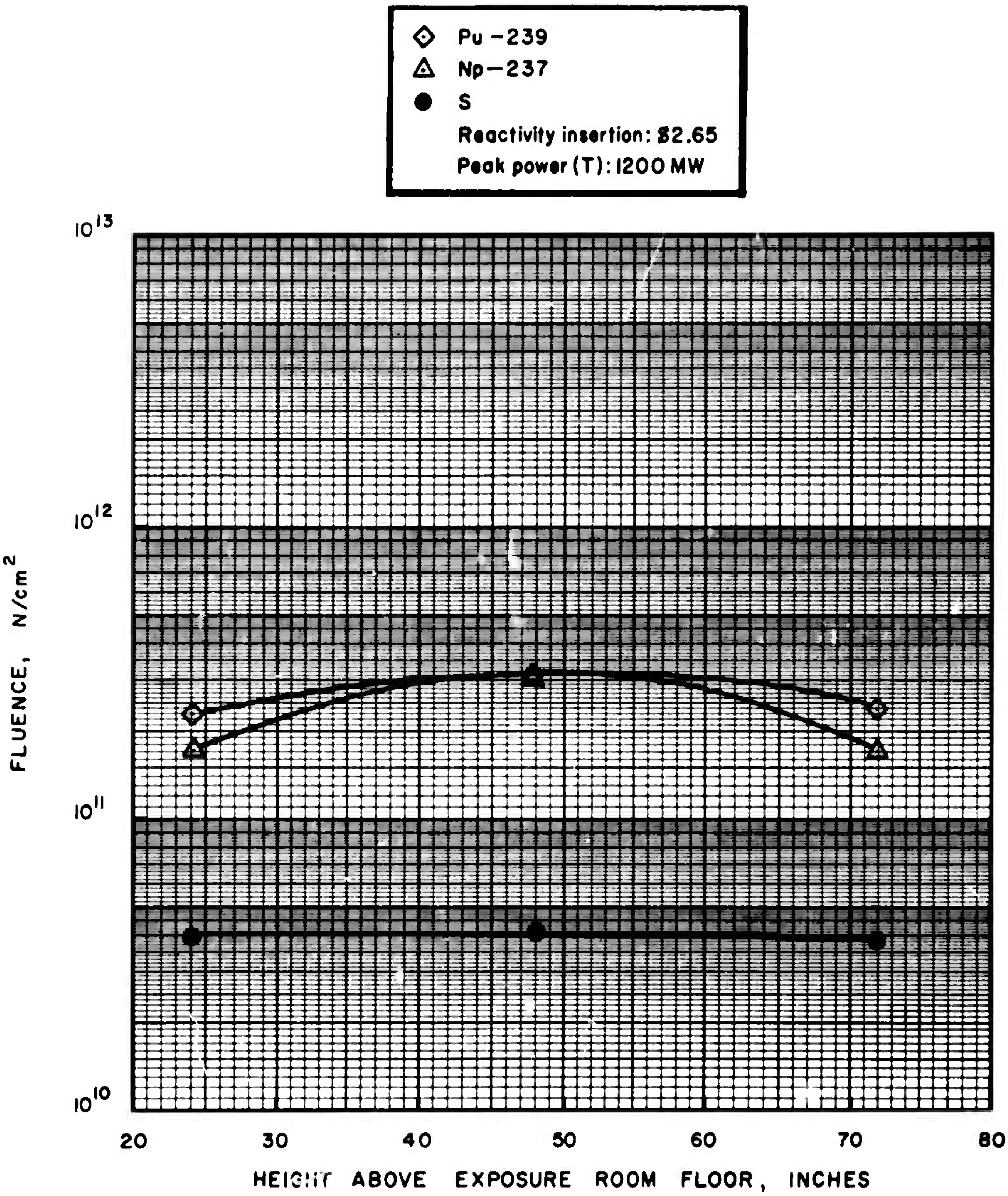


FIGURE 95. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 100 INCHES FROM EXPOSURE ROOM WINDOW, 60° FROM ROOM MIDLINE (SEE FIGURE 10).

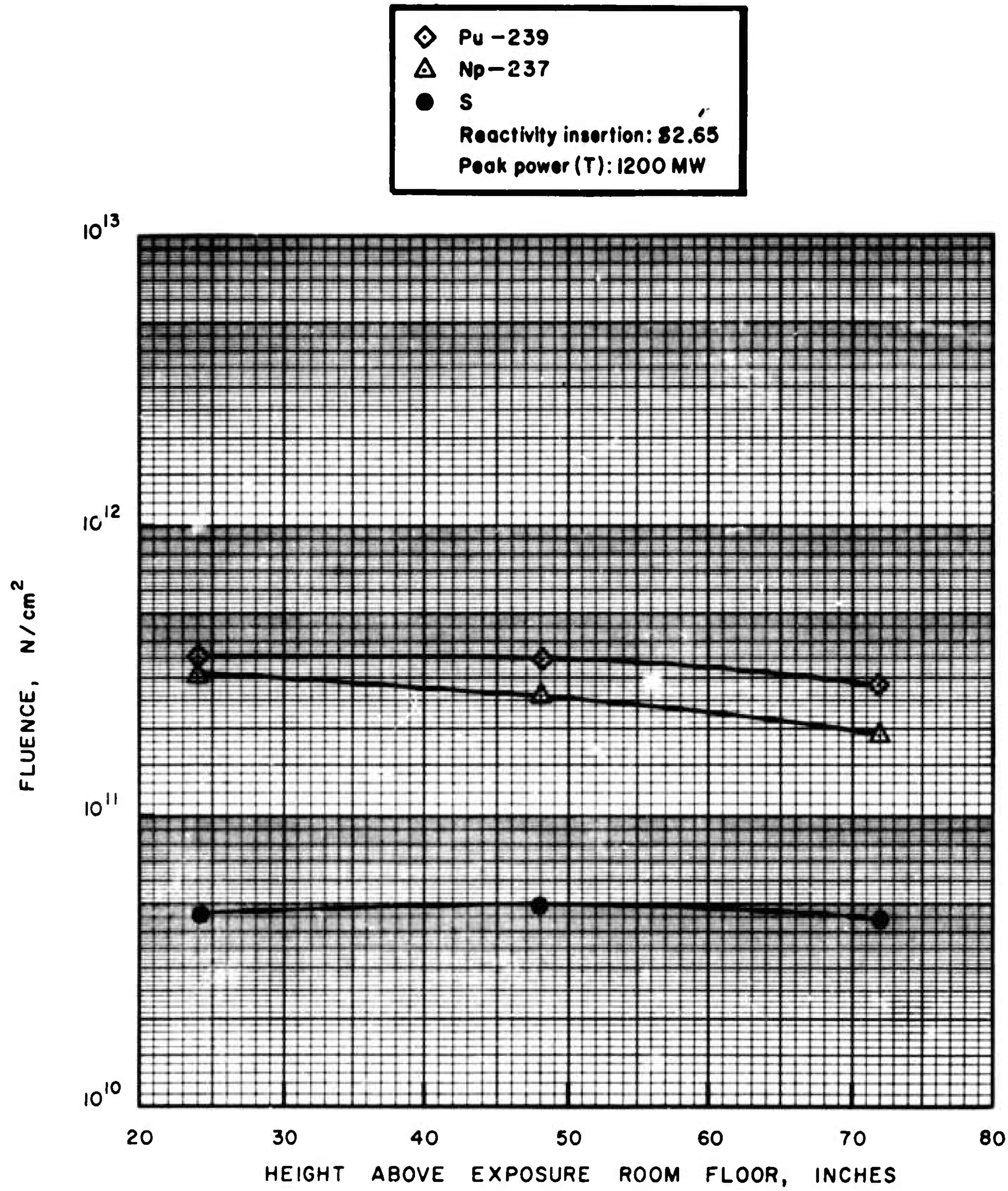


FIGURE 96. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 100 INCHES FROM EXPOSURE ROOM WINDOW, 30° FROM ROOM MIDLINE (SEE FIGURE 10).

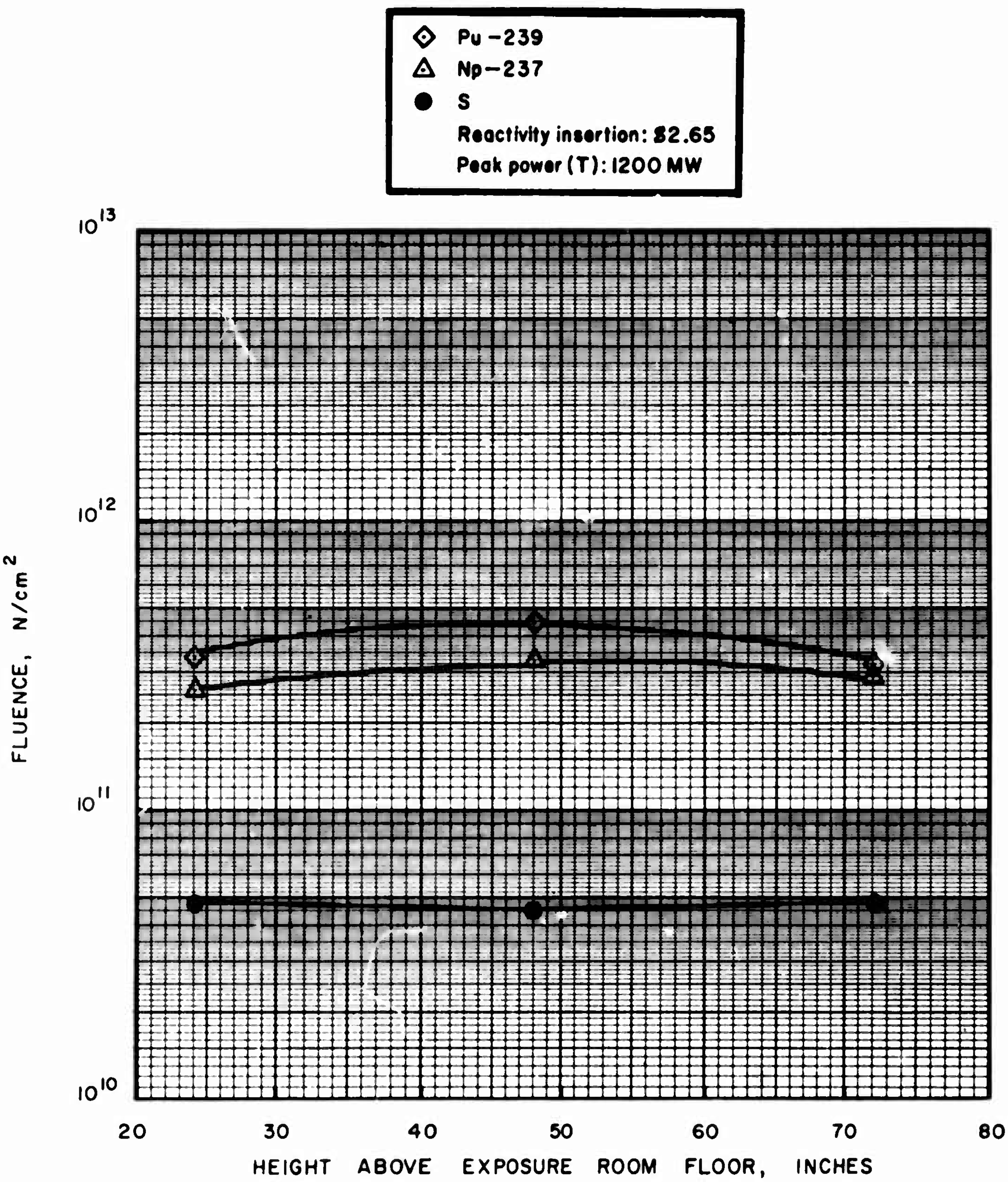


FIGURE 97. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 100 INCHES FROM EXPOSURE ROOM WINDOW, ON ROOM MIDLINE (SEE FIGURE 10).

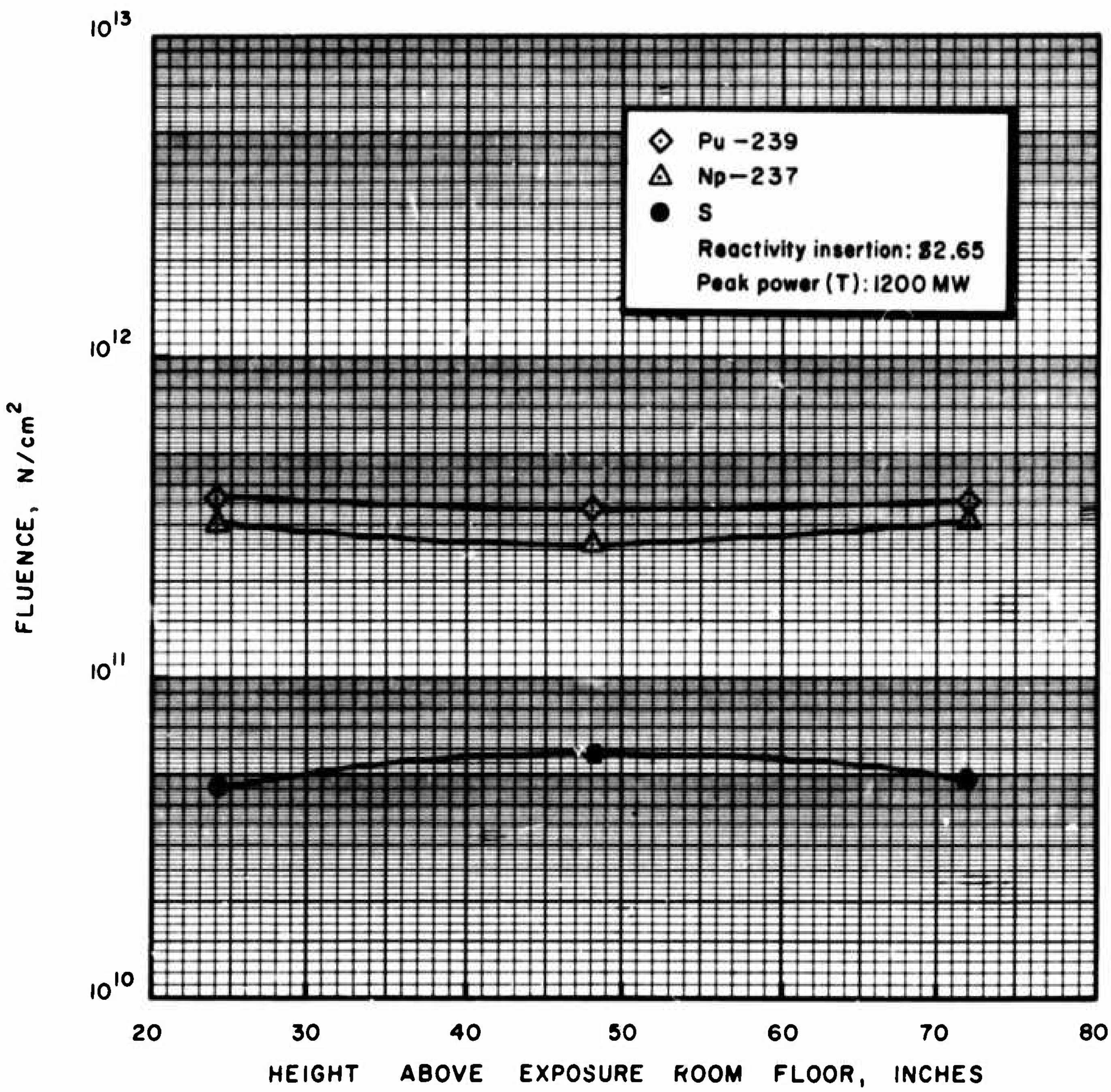


FIGURE 98. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 100 INCHES FROM EXPOSURE ROOM WINDOW, −15° FROM ROOM MIDLINE (SEE FIGURE 10).

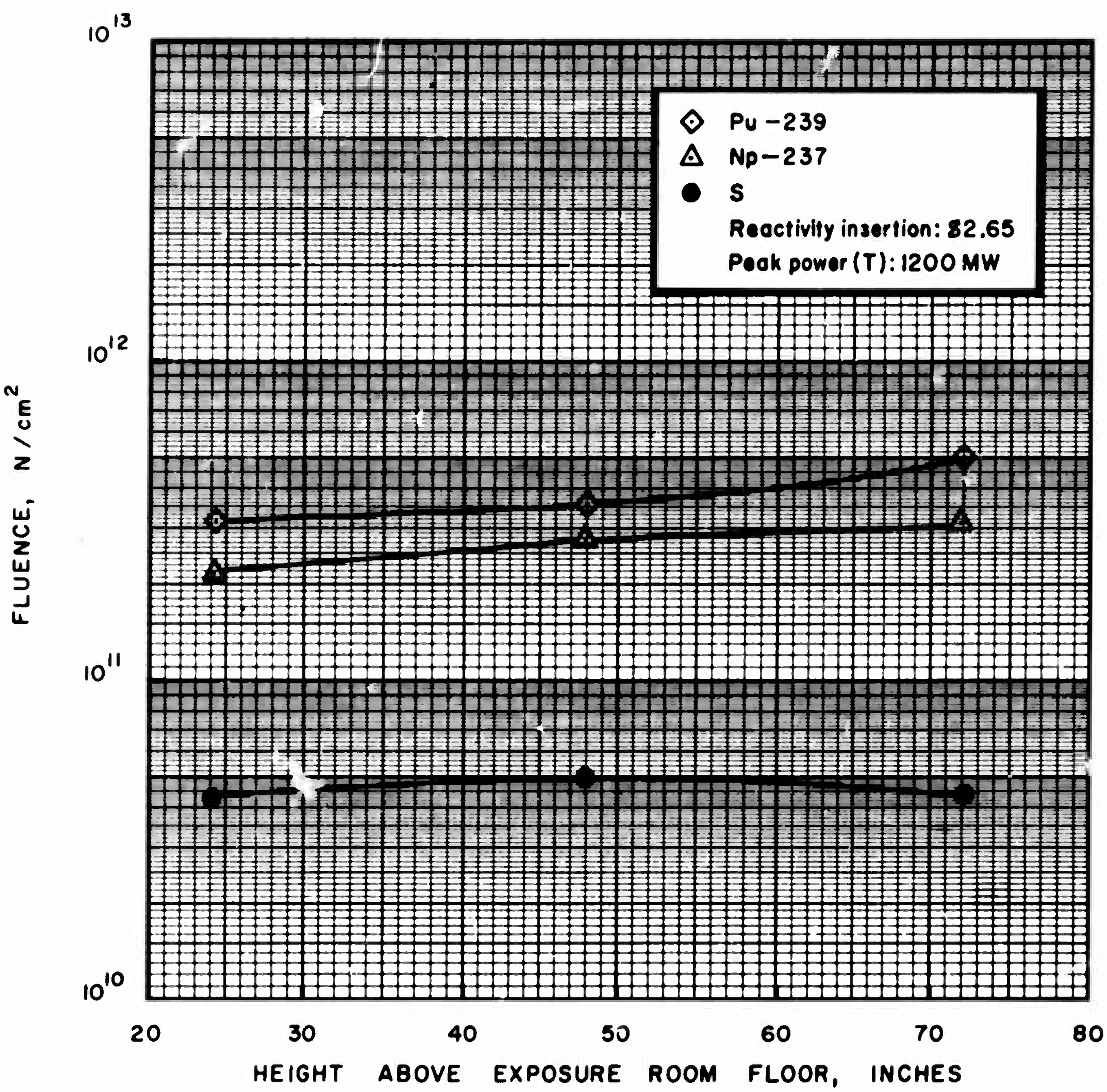


FIGURE 99. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 100 INCHES FROM EXPOSURE ROOM WINDOW, −30° FROM ROOM MIDLINE (SEE FIGURE 10).

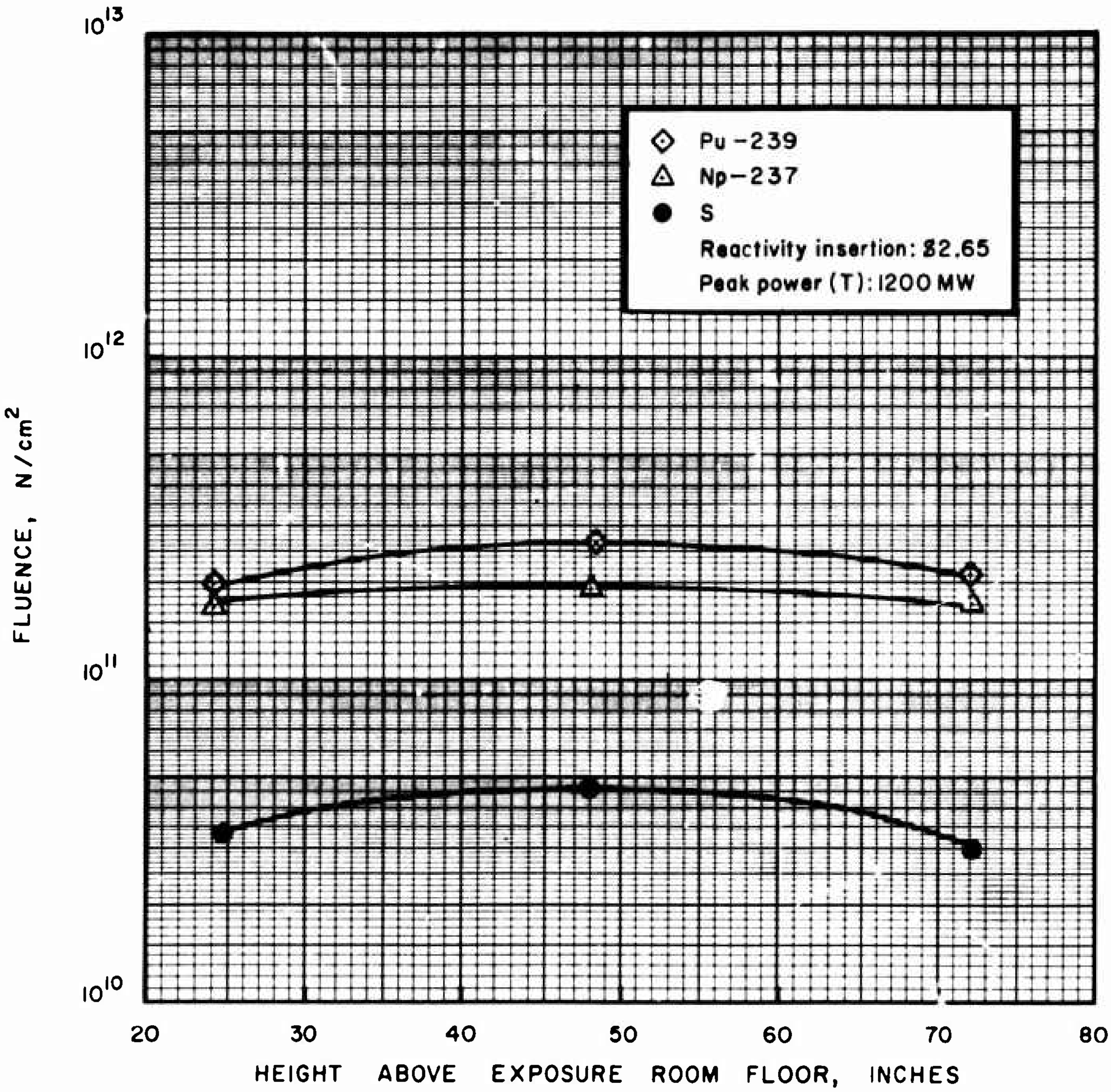


FIGURE 100. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 100 INCHES FROM EXPOSURE ROOM WINDOW, −60° FROM ROOM MIDLINE (SEE FIGURE 10).

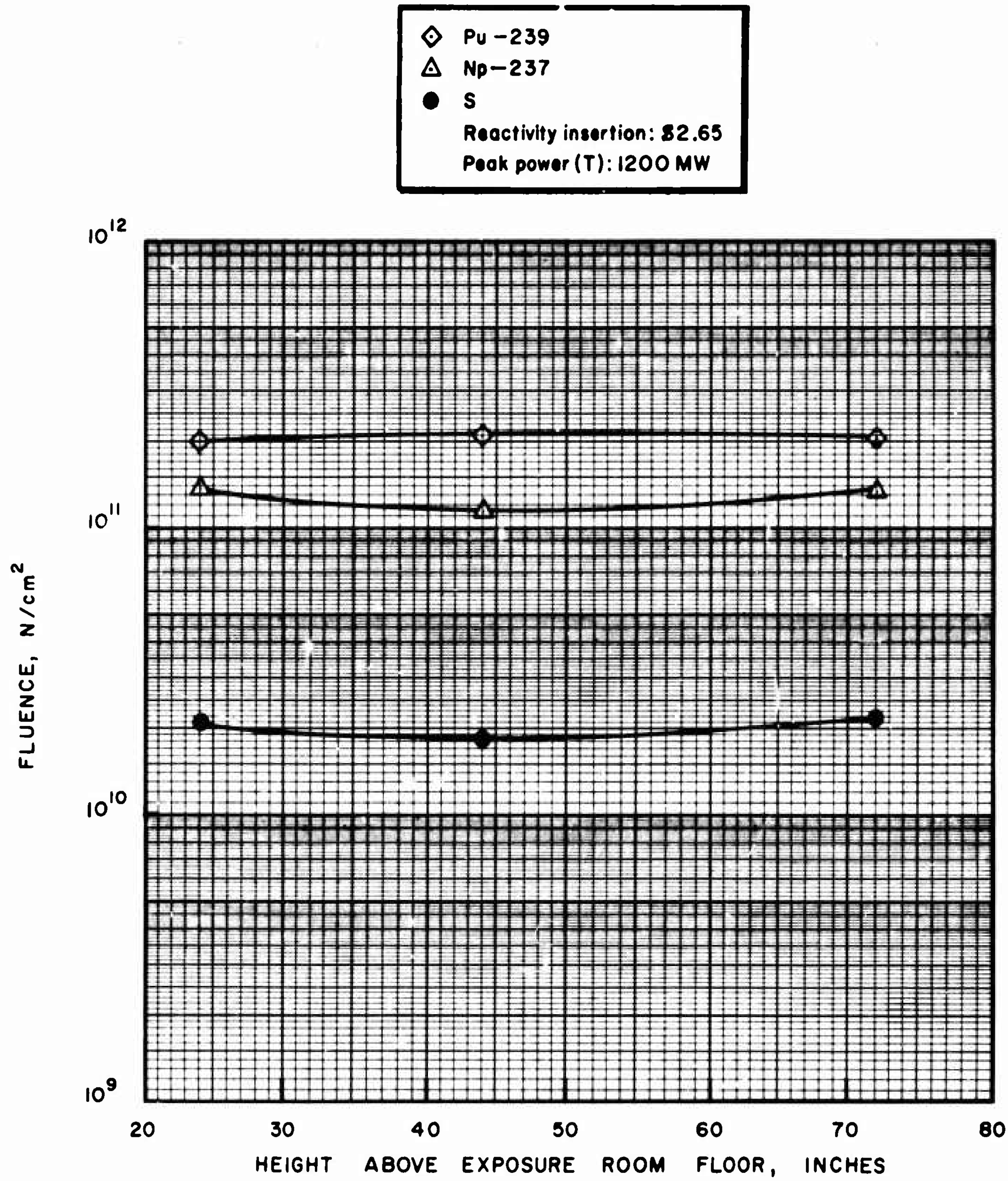


FIGURE 101. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 156 INCHES FROM EXPOSURE ROOM WINDOW, 30° FROM ROOM MIDLINE (SEE FIGURE 10).

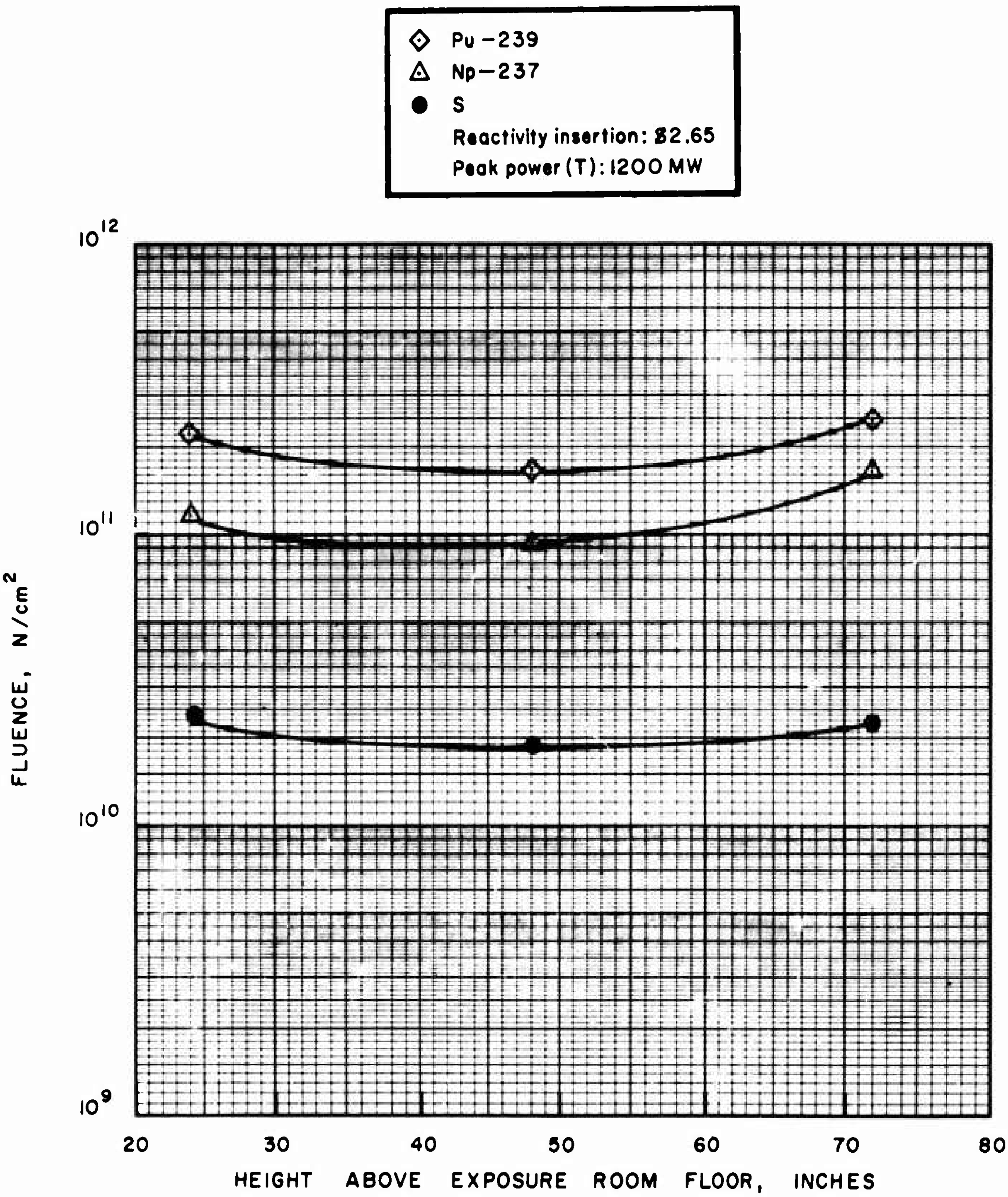


FIGURE 102. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 156 INCHES FROM EXPOSURE ROOM WINDOW, 15° FROM ROOM MIDLINE (SEE FIGURE 10).

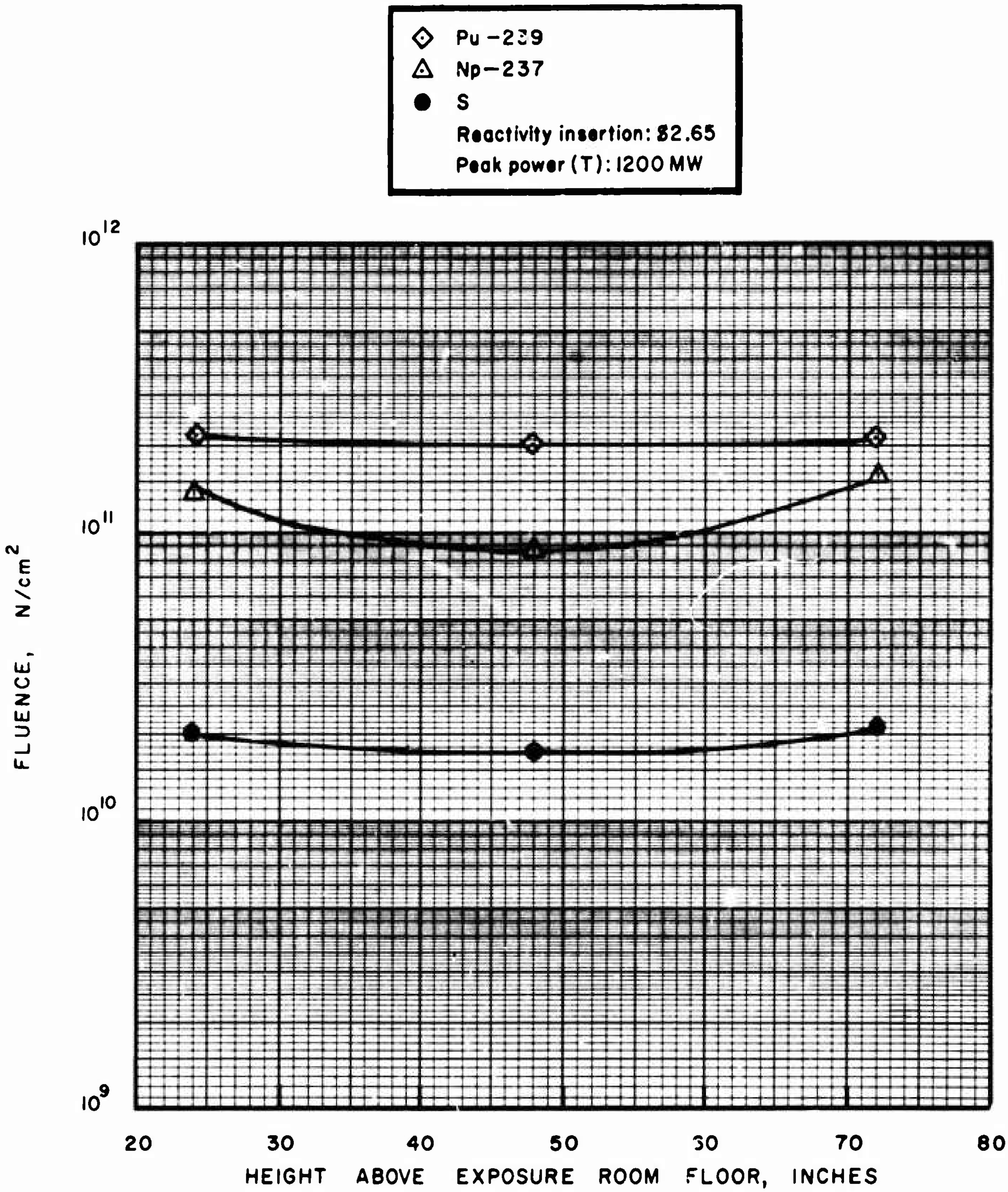


FIGURE 103. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 156 INCHES FROM EXPOSURE ROOM WINDOW, ON ROOM MIDLINE (SEE FIGURE 10).

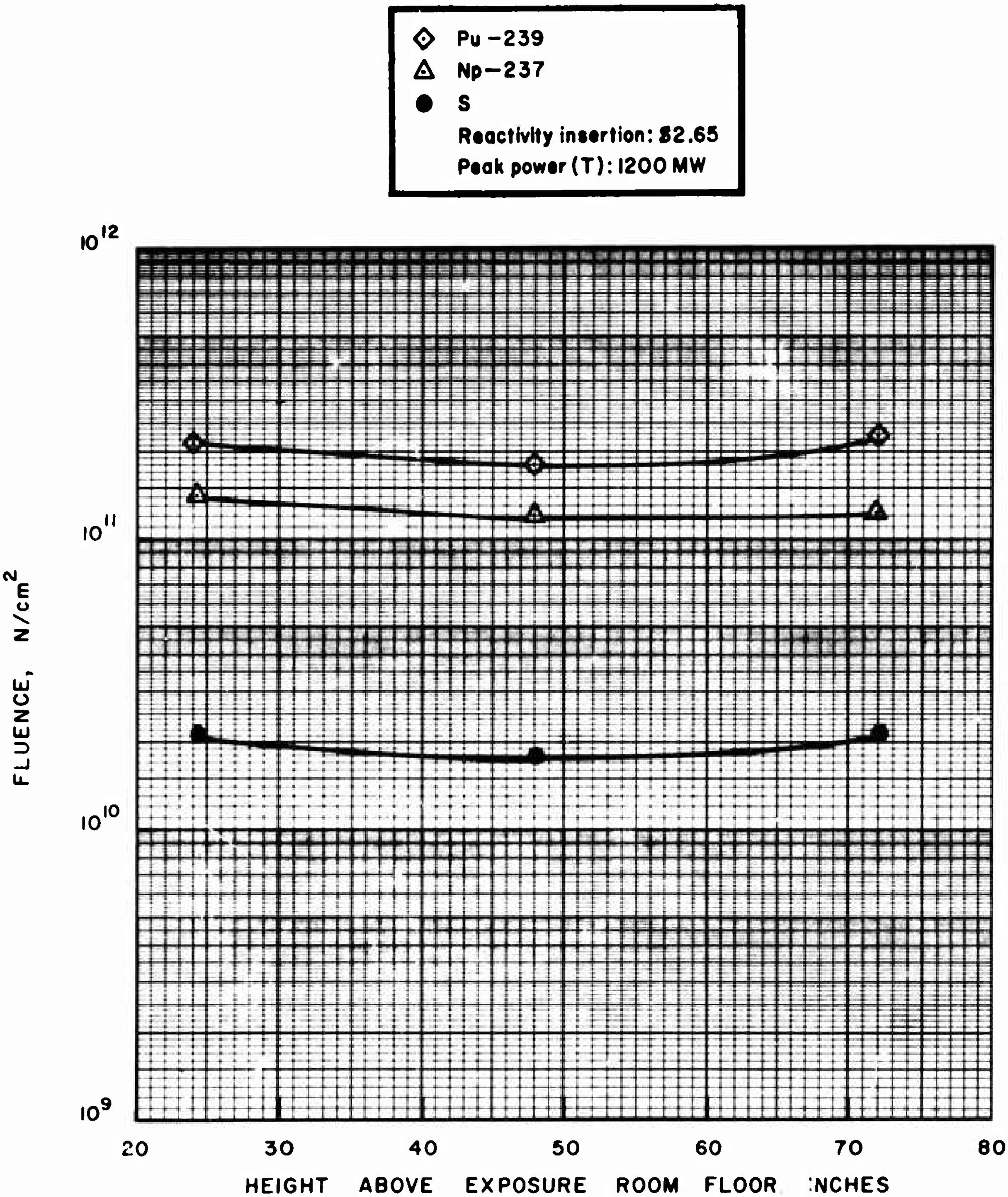


FIGURE 104. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 156 INCHES FROM EXPOSURE ROOM WINDOW, -15° FROM ROOM MIDLINE (SEE FIGURE 10).

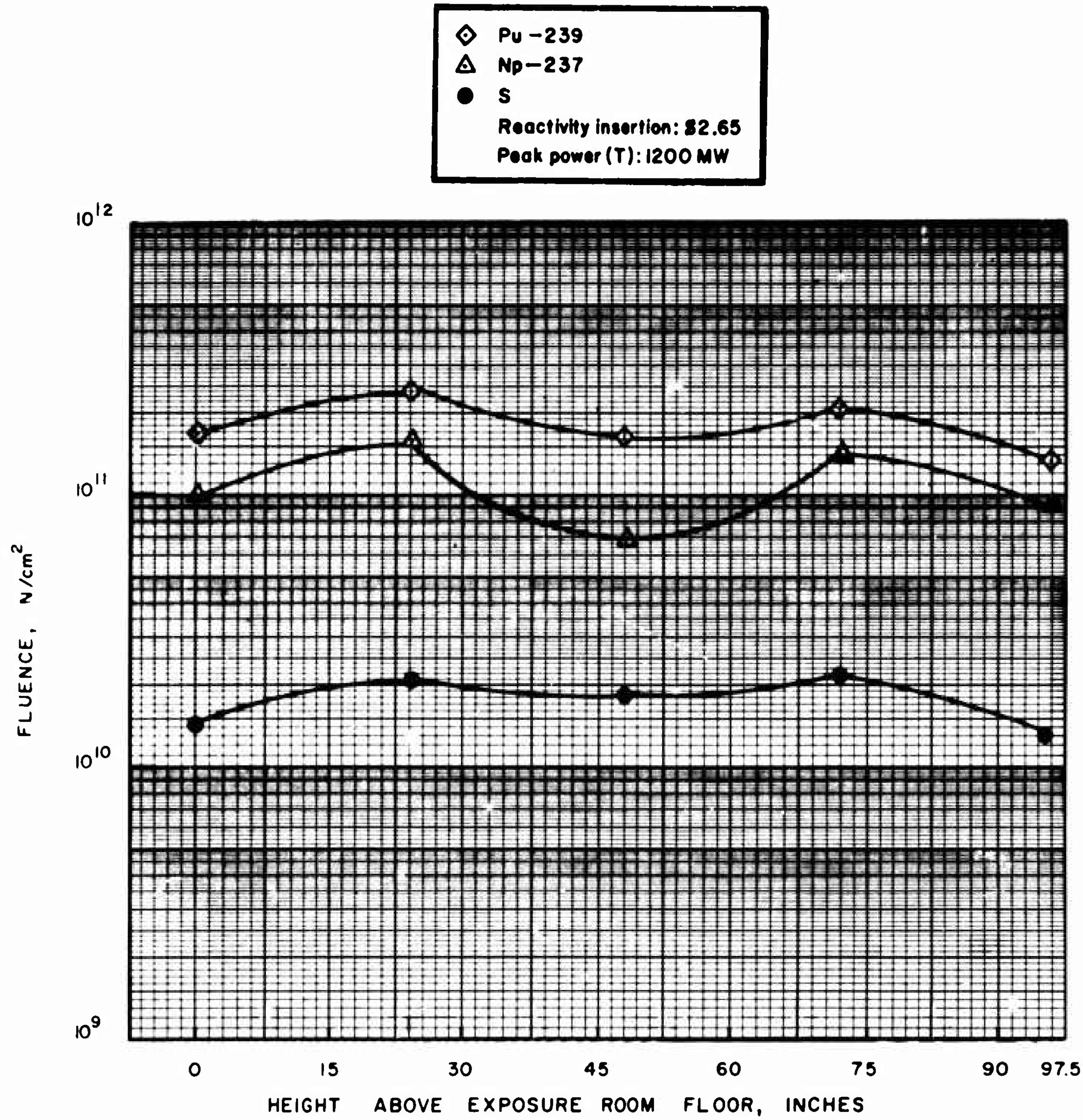


FIGURE 105. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 156 INCHES FROM EXPOSURE ROOM WINDOW,- 30° FROM ROOM MIDLINE (SEE FIGURE 10).

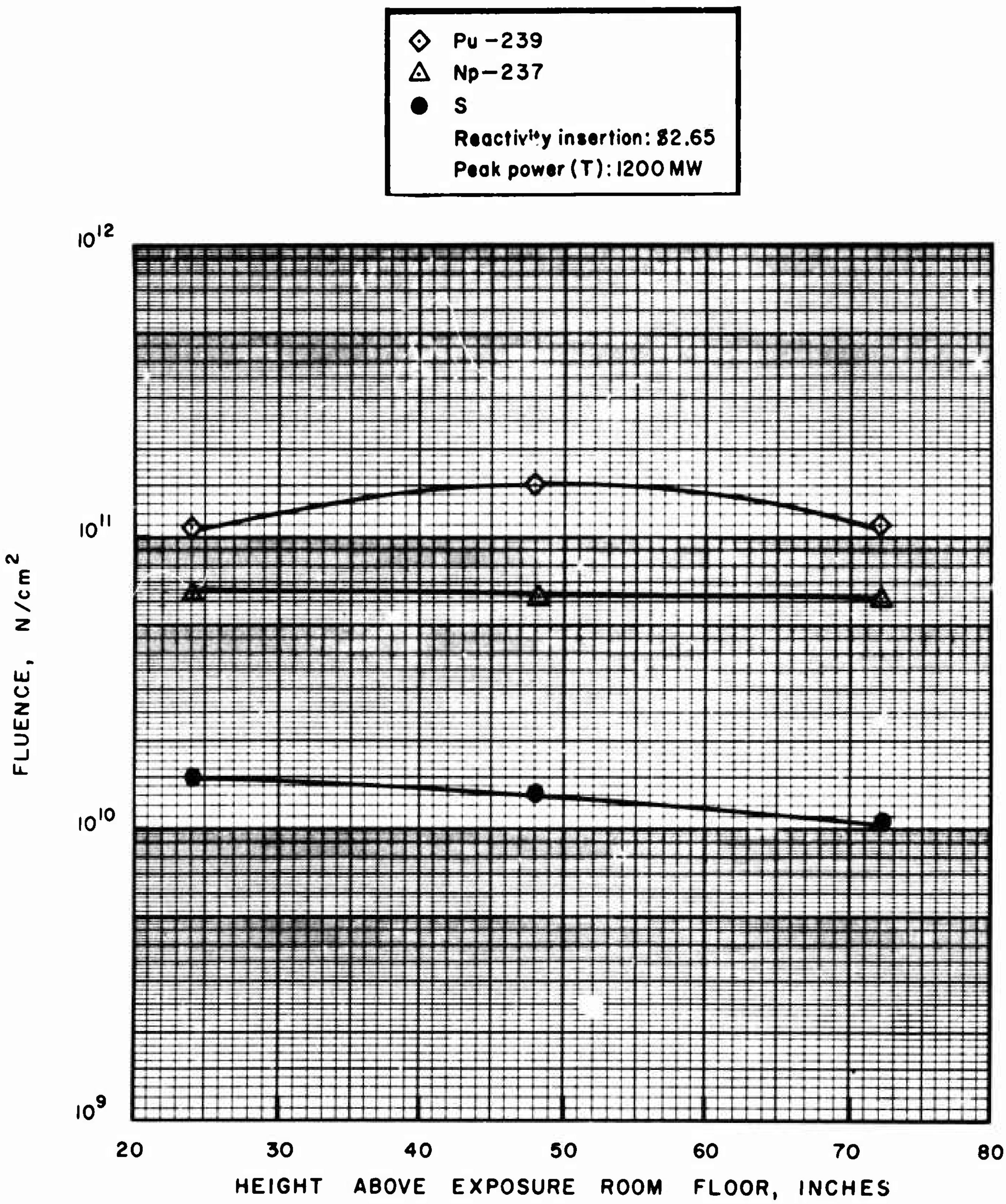


FIGURE 106. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 206 INCHES FROM EXPOSURE ROOM WINDOW, 30° FROM ROOM MIDLINE (SEE FIGURE 10).

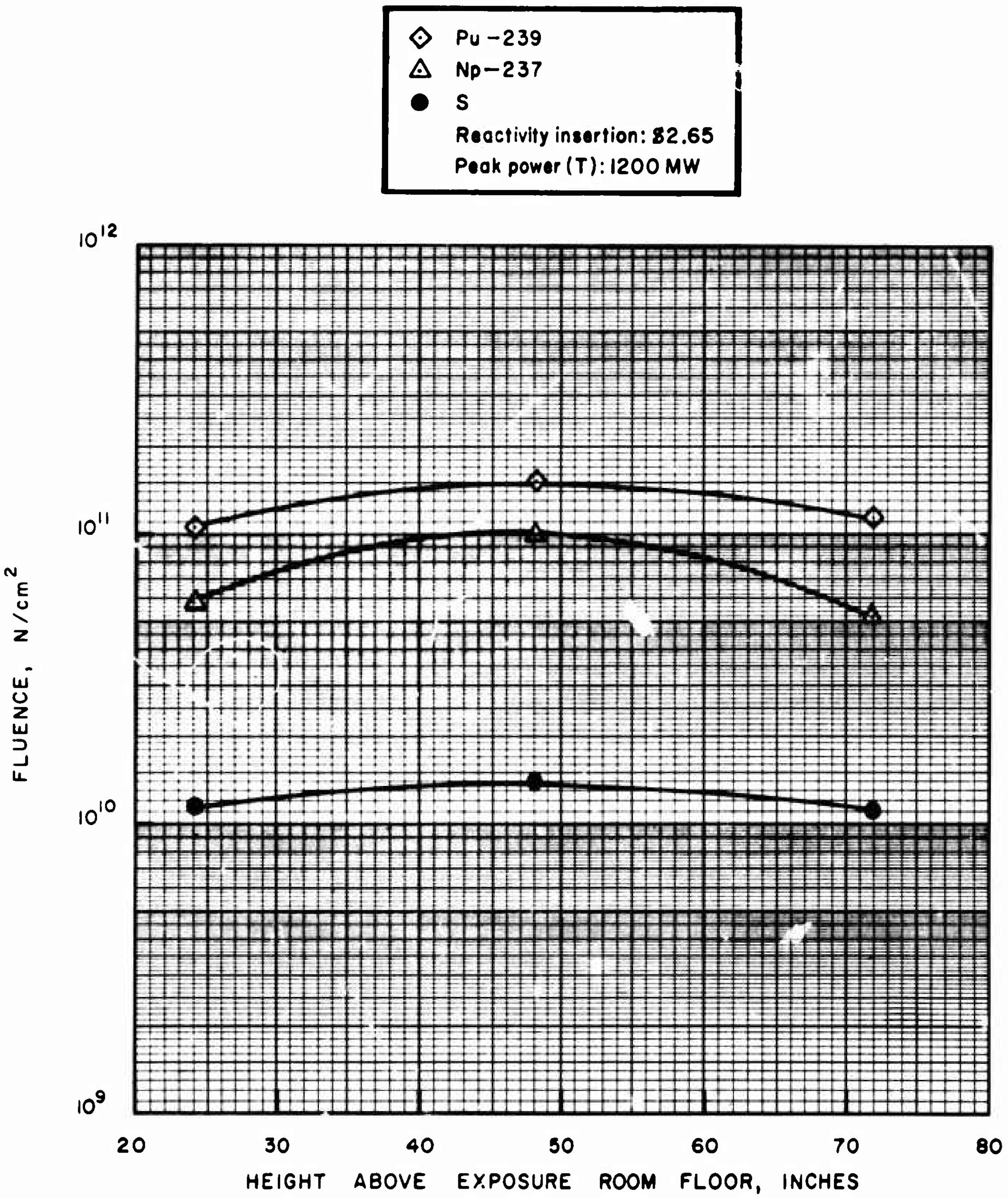


FIGURE 107. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 206 INCHES FROM EXPOSURE ROOM WINDOW, 15° FROM ROOM MIDLINE (SEE FIGURE 10).

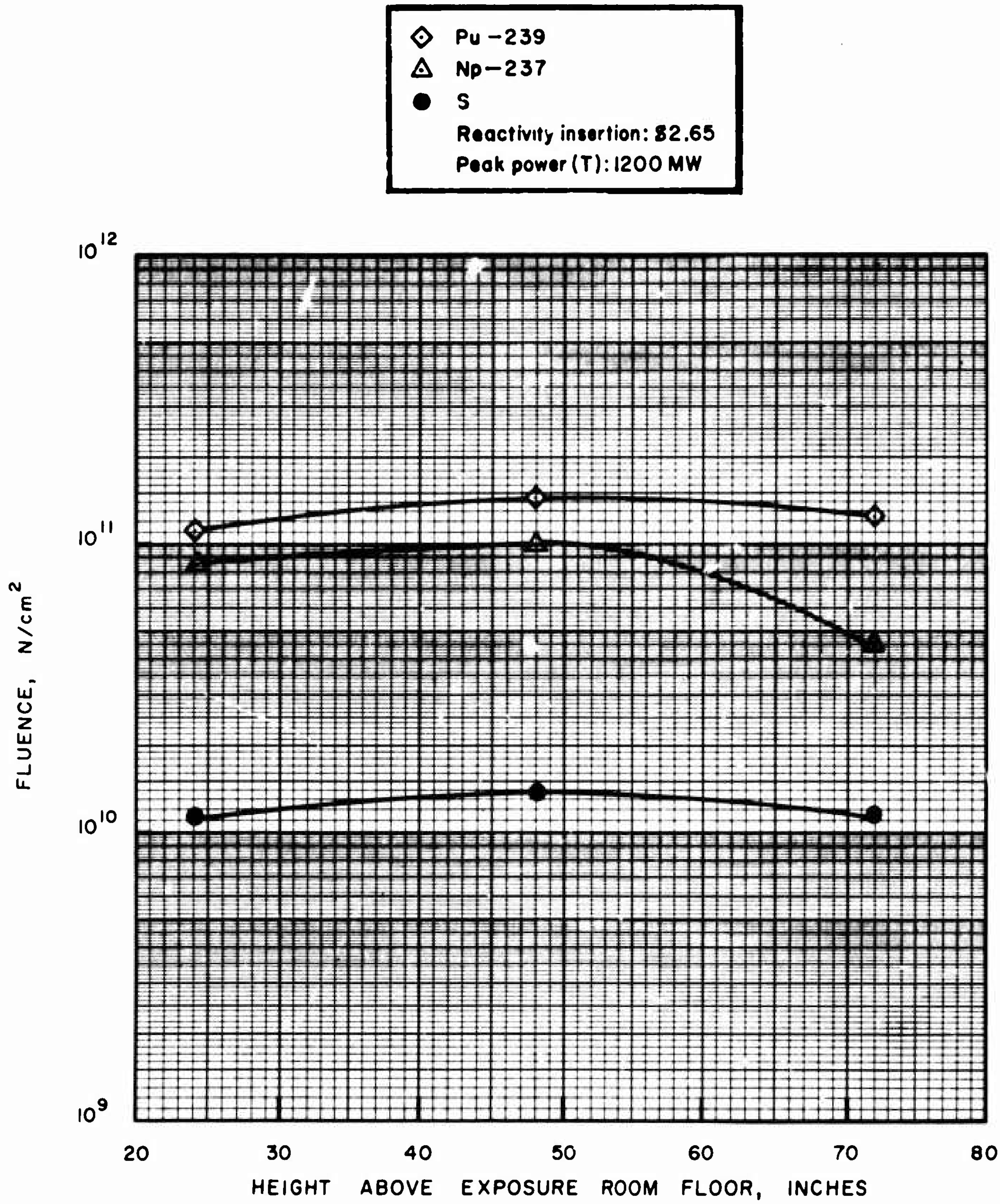


FIGURE 108. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 206 INCHES FROM EXPOSURE ROOM WINDOW, −15° FROM ROOM MIDLINE (SEE FIGURE 10).

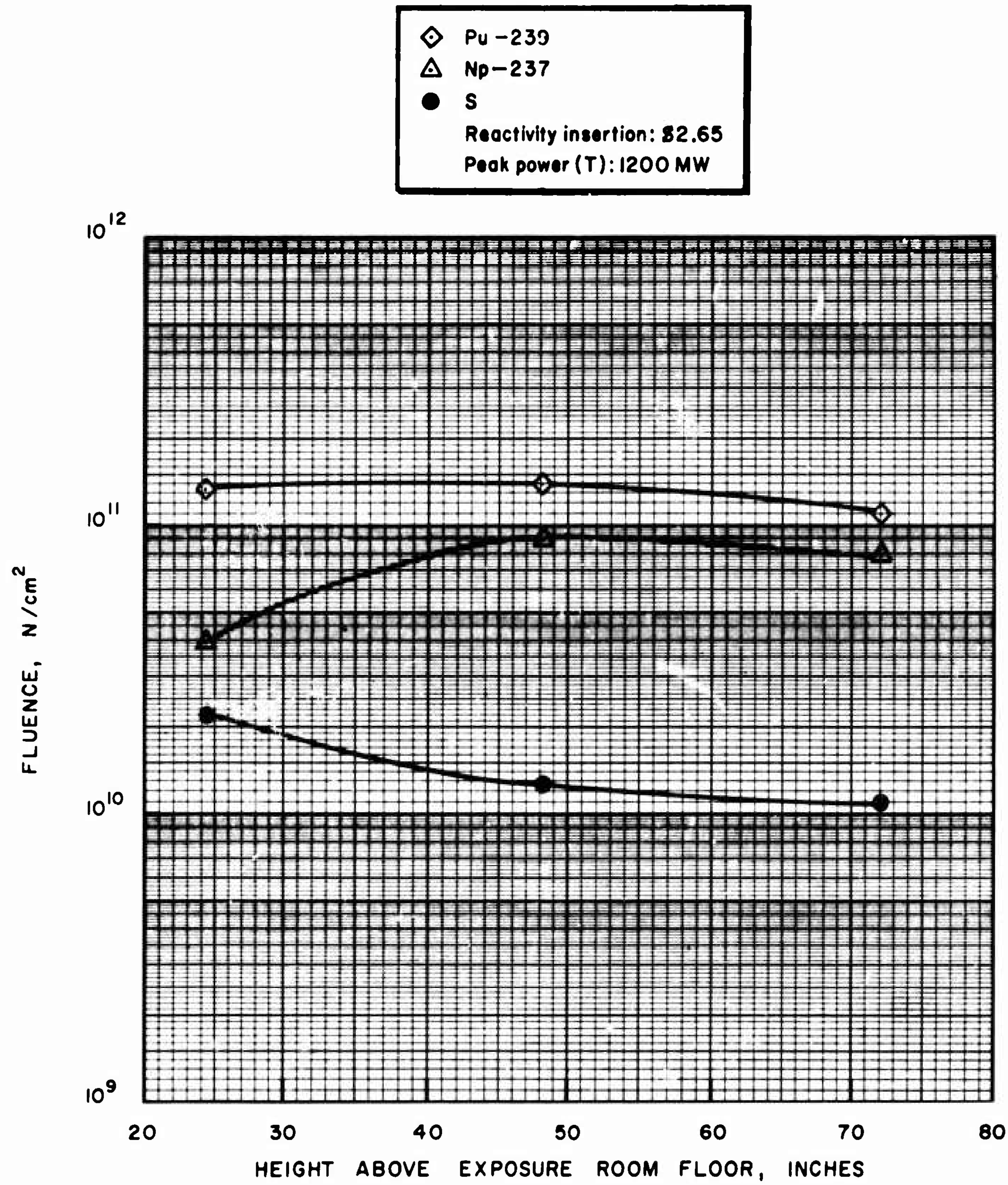


FIGURE 109. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 206 INCHES FROM EXPOSURE ROOM WINDOW, ON ROOM MIDLINE (SEE FIGURE 10).

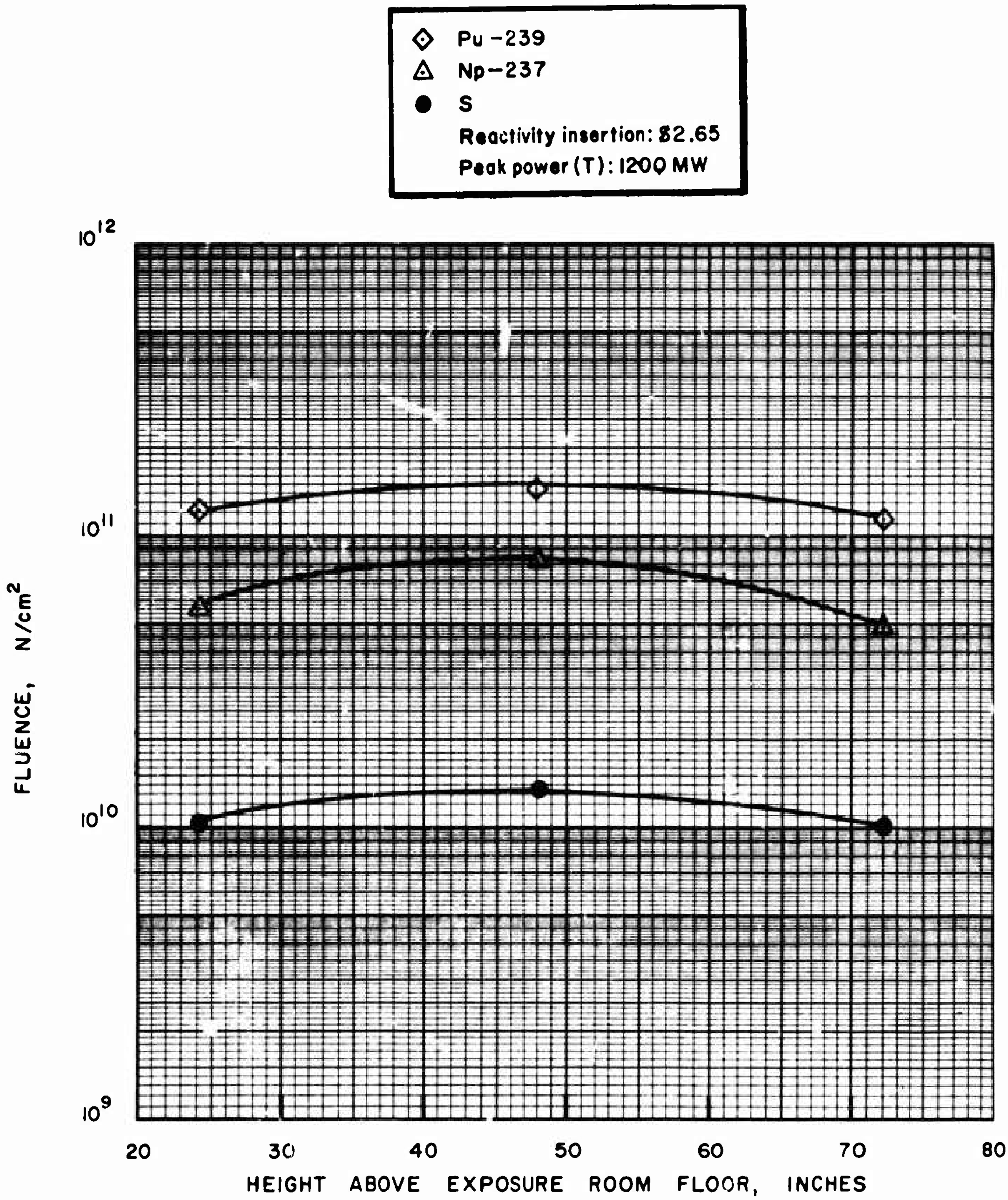


FIGURE 110. EXPOSURE ROOM VERTICAL FAST NEUTRON FIELD GRADIENT, 206 INCHES FROM EXPOSURE ROOM WINDOW, −30° FROM ROOM MIDLINE (SEE FIGURE 10).

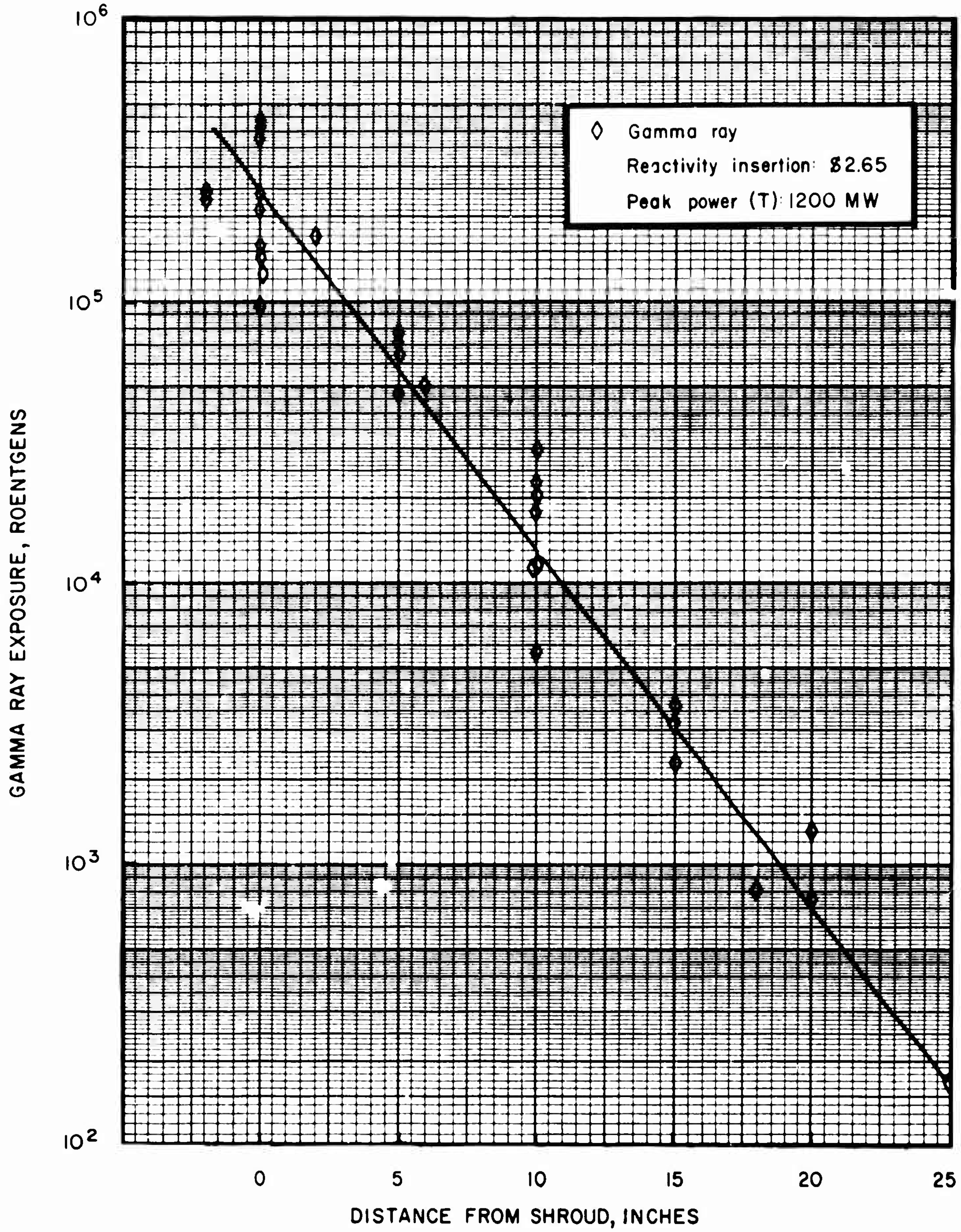


FIGURE 111. POOL GAMMA RAY FIELD GRADIENT, 29 INCHES ABOVE POOL FLOOR, ON MIDLINE (SEE FIGURE 8).

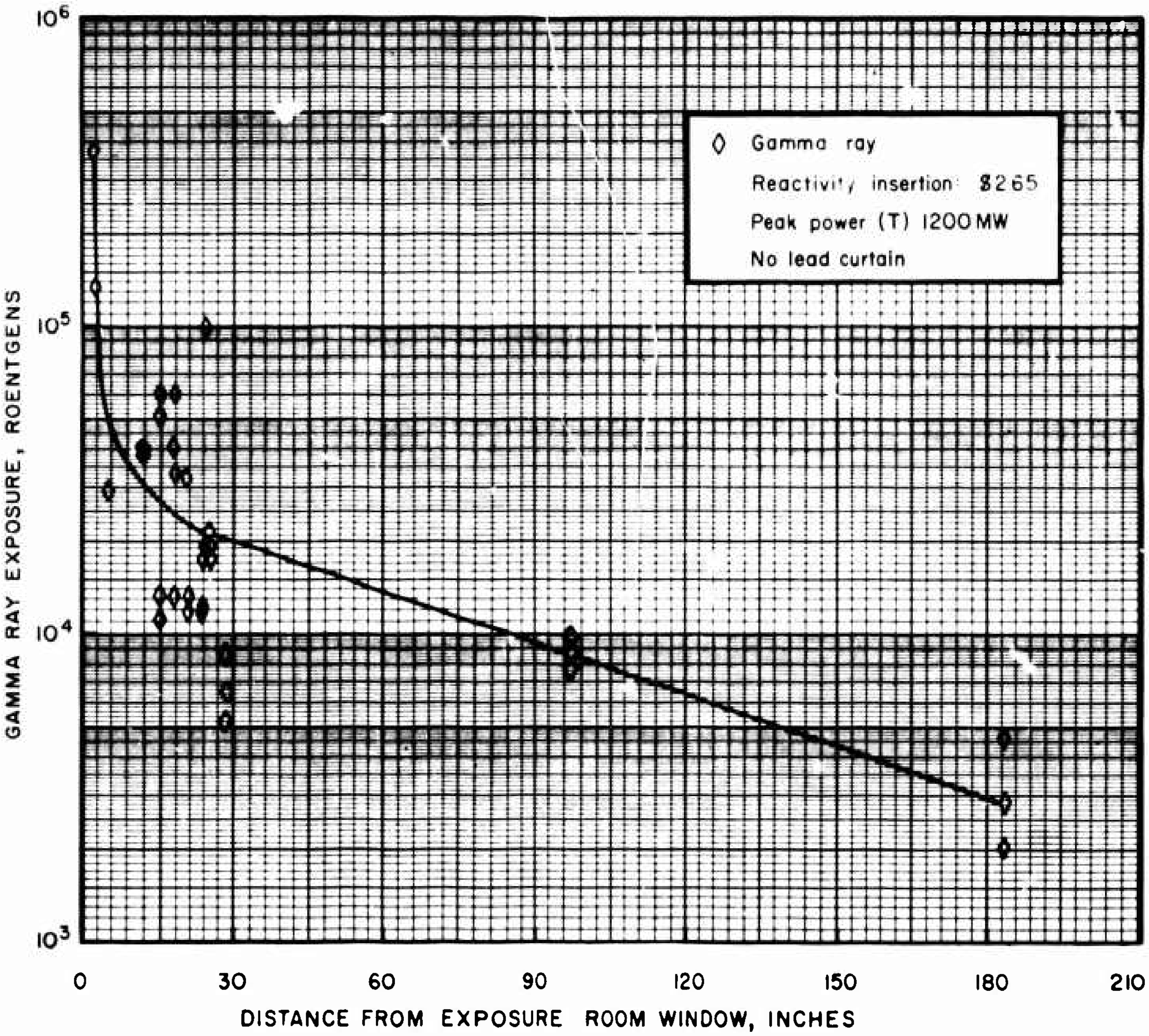


FIGURE 112. EXPOSURE ROOM GAMMA RAY FIELD GRADIENT, 48 INCHES ABOVE EXPOSURE ROOM FLOOR, ON MIDLINE (SEE FIGURE 10)

GAMMA RAY EXPOSURE, ROENTGENS

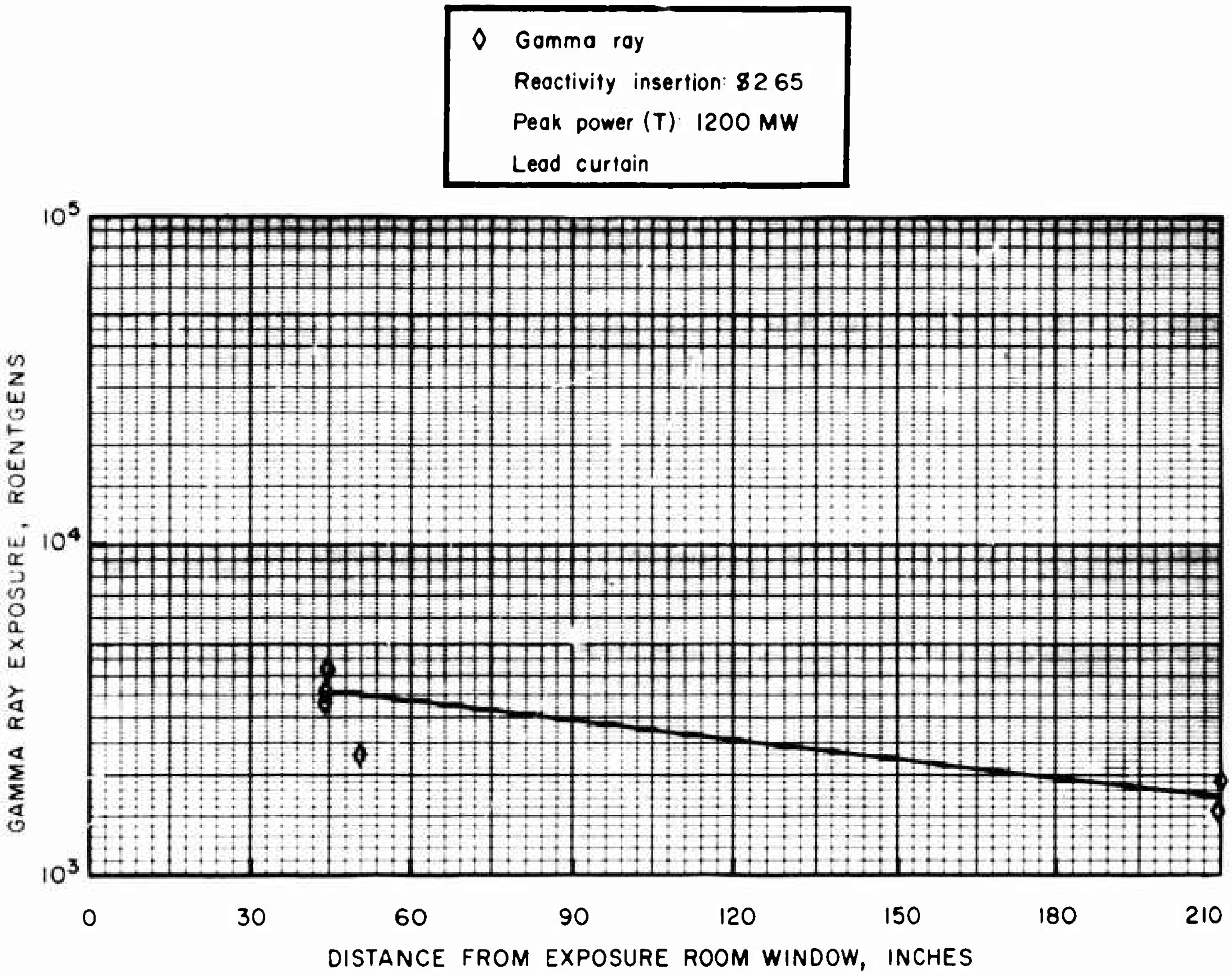


FIGURE 113. EXPOSURE ROOM GAMMA RAY FIELD GRADIENT, 48 INCHES ABOVE EXPOSURE ROOM FLOOR, ON MIDLINE (SEE FIGURE 10).

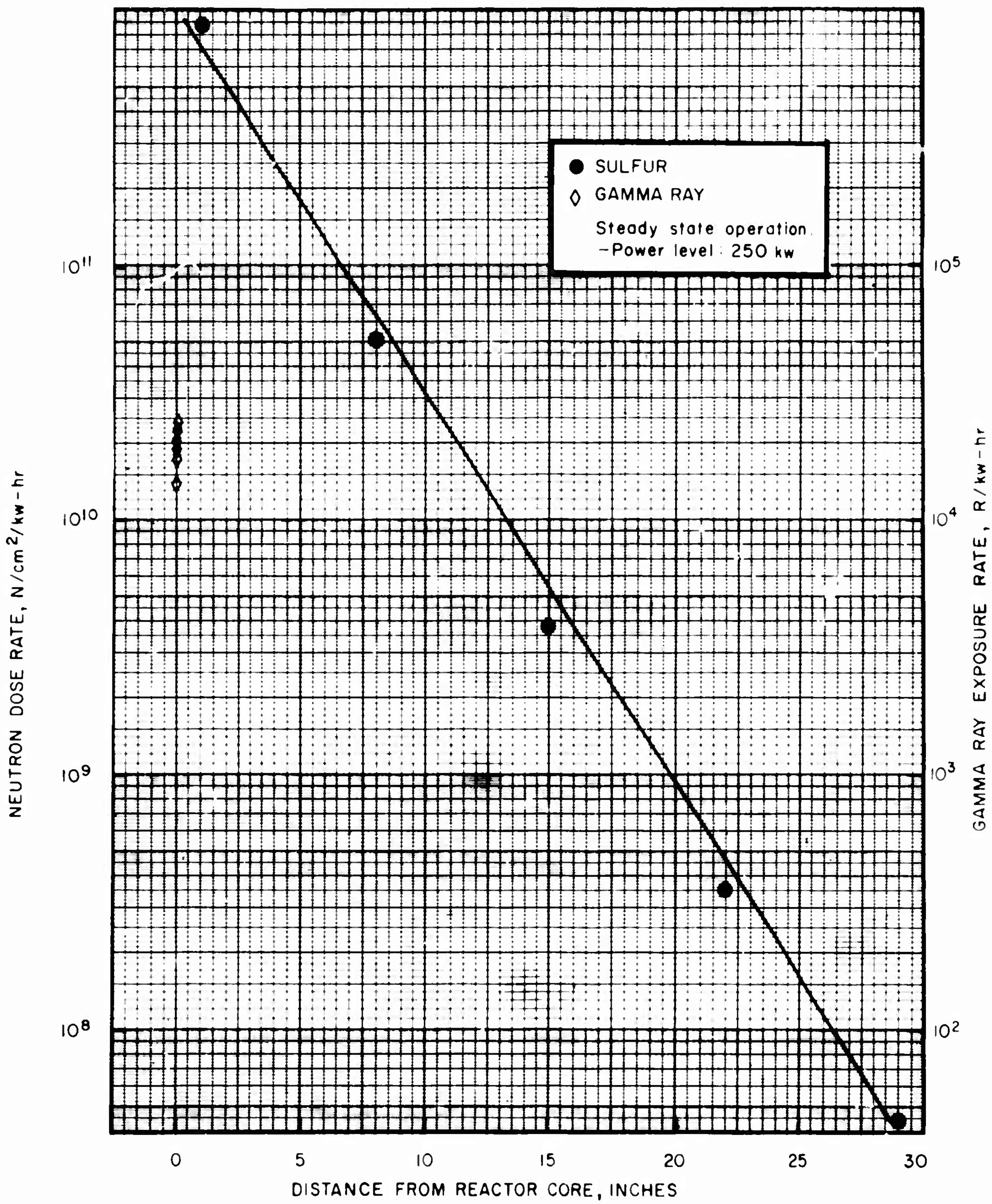


FIGURE 114. POOL FAST NEUTRON AND GAMMA RAY, 29 INCHES ABOVE POOL FLOOR, ON MIDLINE (SEE FIGURE 8).

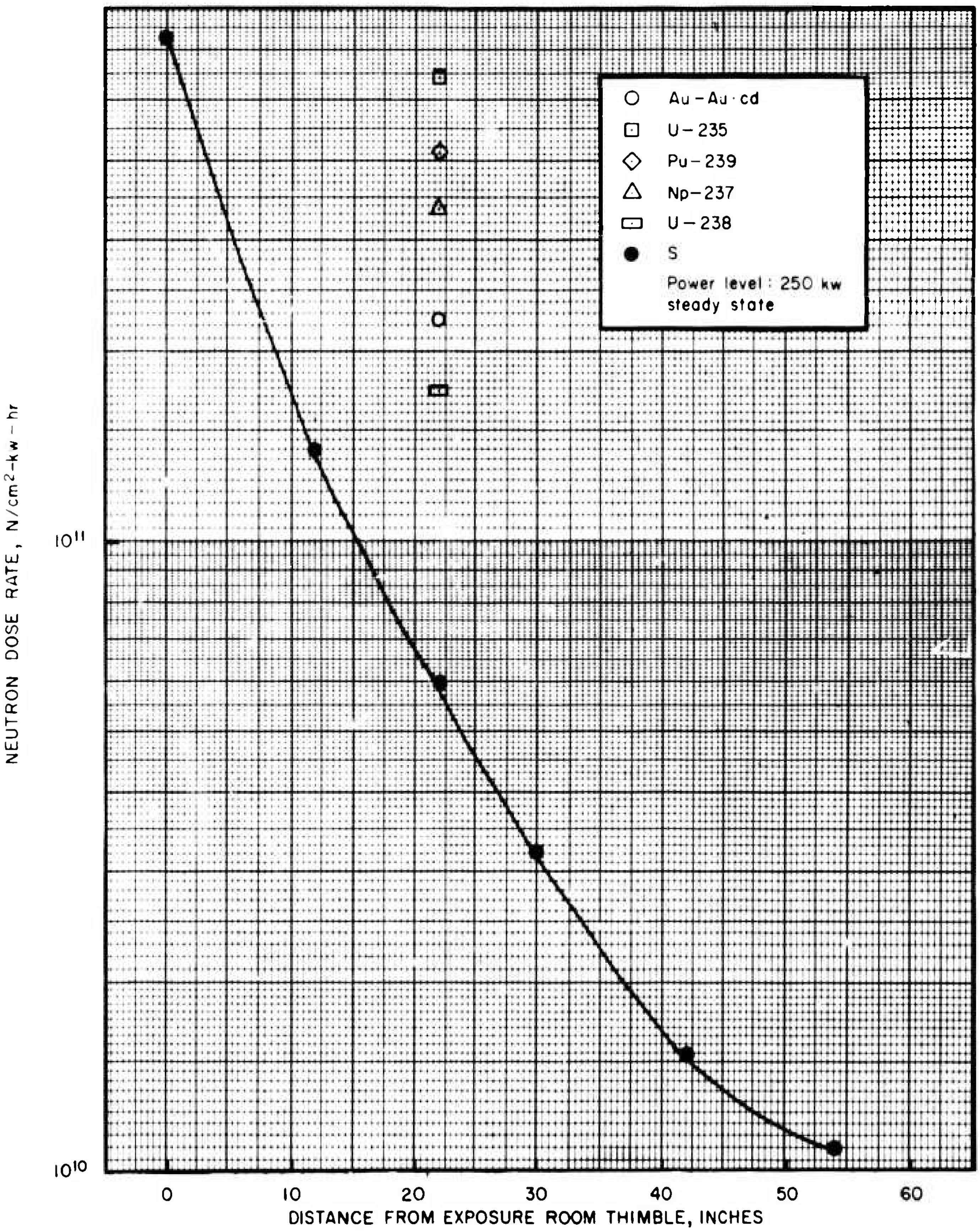


FIGURE 115. NEUTRON DOSE RATE IN EXPOSURE ROOM, 48 INCHES ABOVE FLOOR, ON ROOM MIDLINE (SEE FIGURE 10).

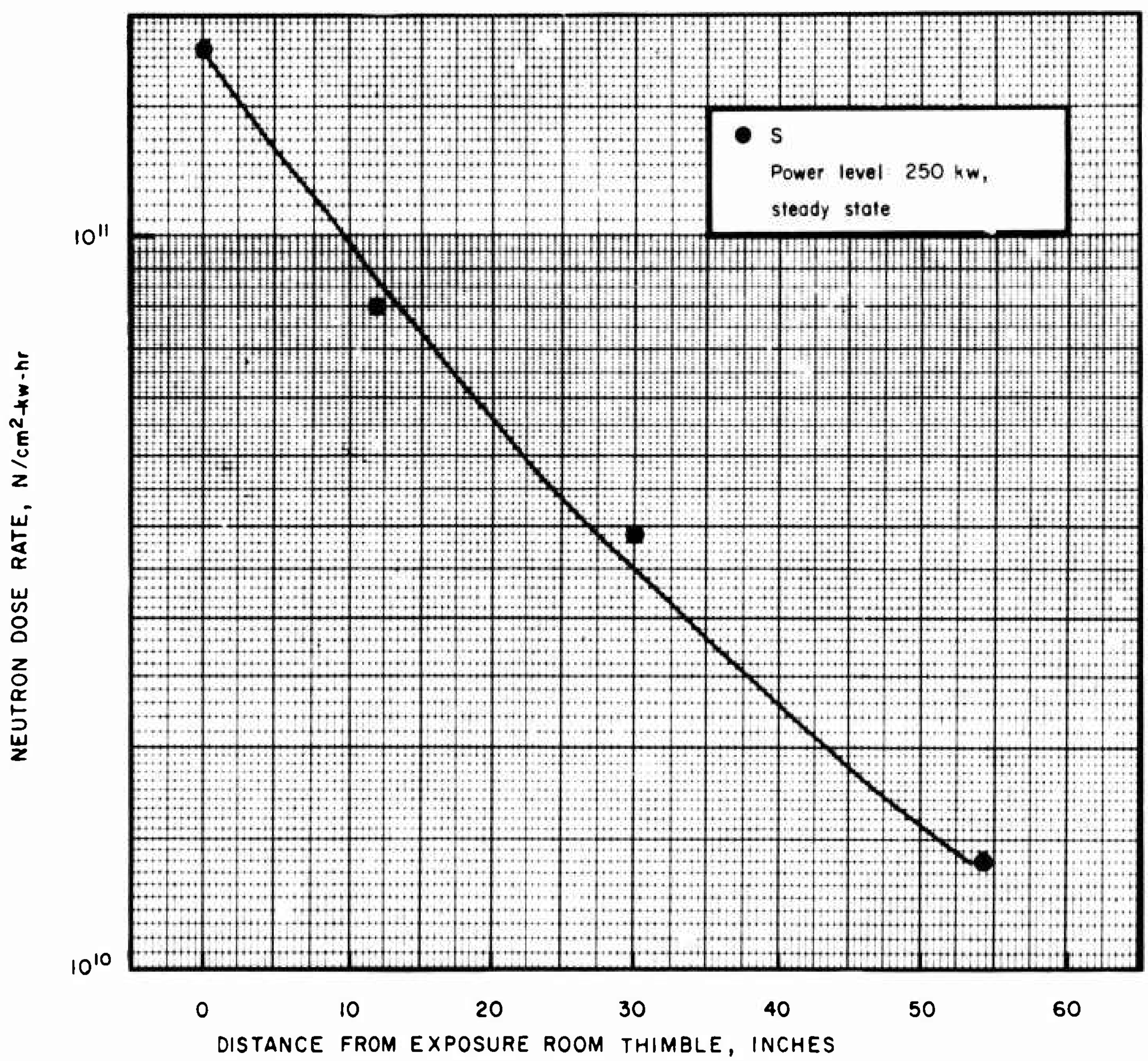


FIGURE 116. NEUTRON DOSE RATE IN EXPOSURE ROOM, 58 INCHES ABOVE FLOOR, ON ROOM MIDLINE (SEE FIGURE 10).

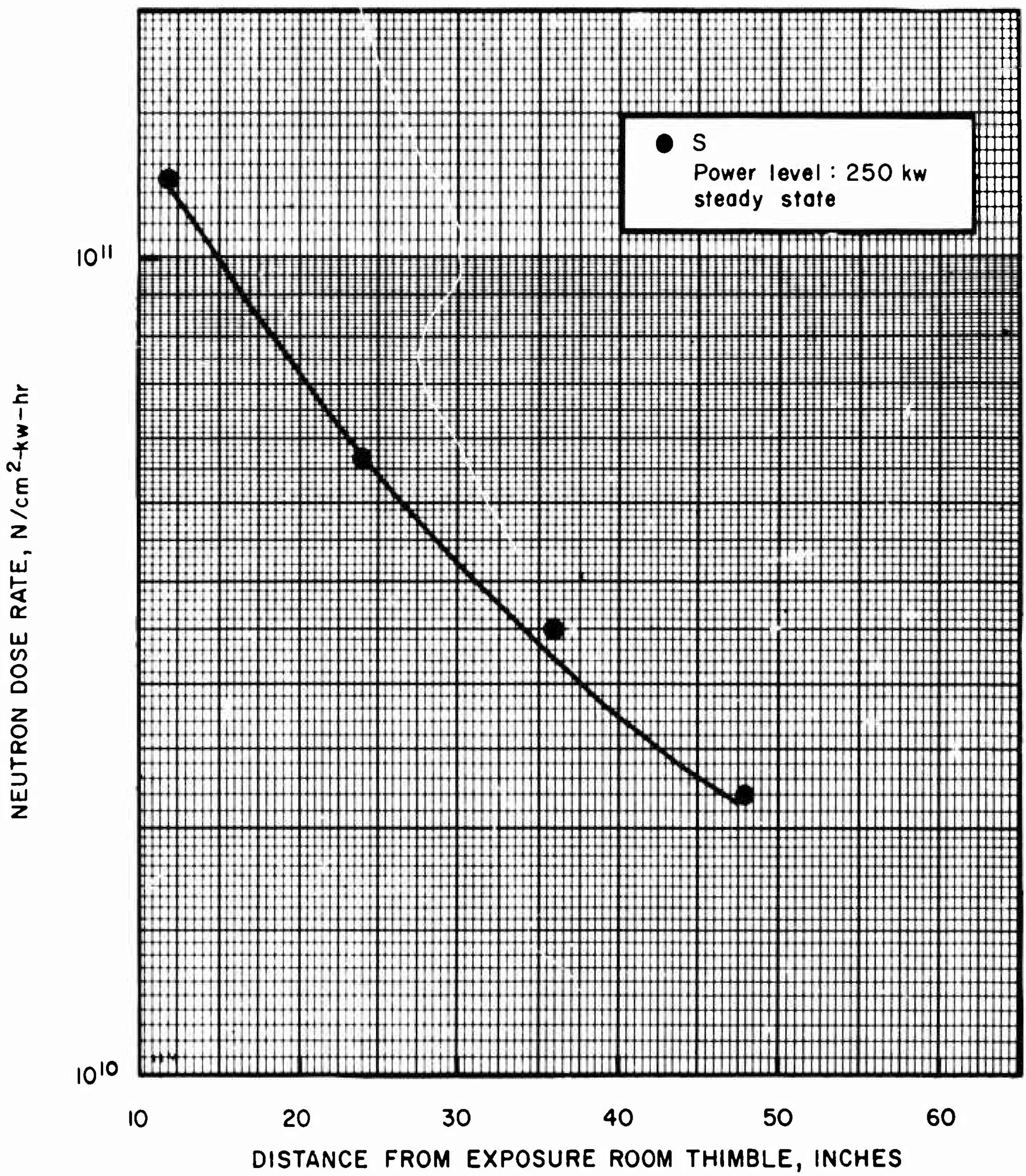


FIGURE 117. NEUTRON DOSE RATE IN EXPOSURE ROOM, 48 INCHES ABOVE FLOOR, 60° FROM ROOM MIDLINE (SEE FIGURE 10).

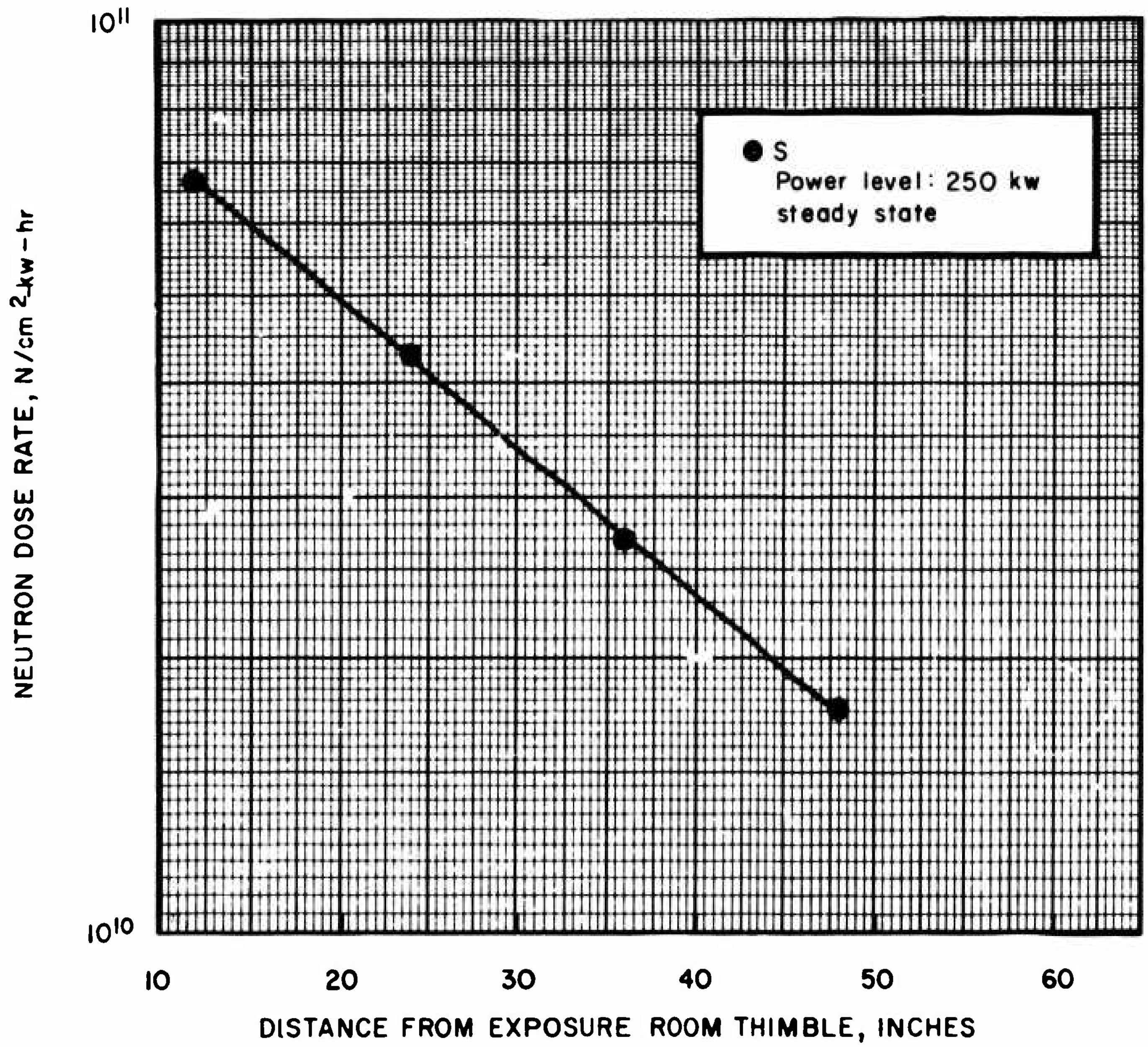


FIGURE 118. NEUTRON DOSE RATE IN EXPOSURE ROOM, 58 INCHES ABOVE FLOOR, 60° FROM ROOM MIDLINE (SEE FIGURE 10).

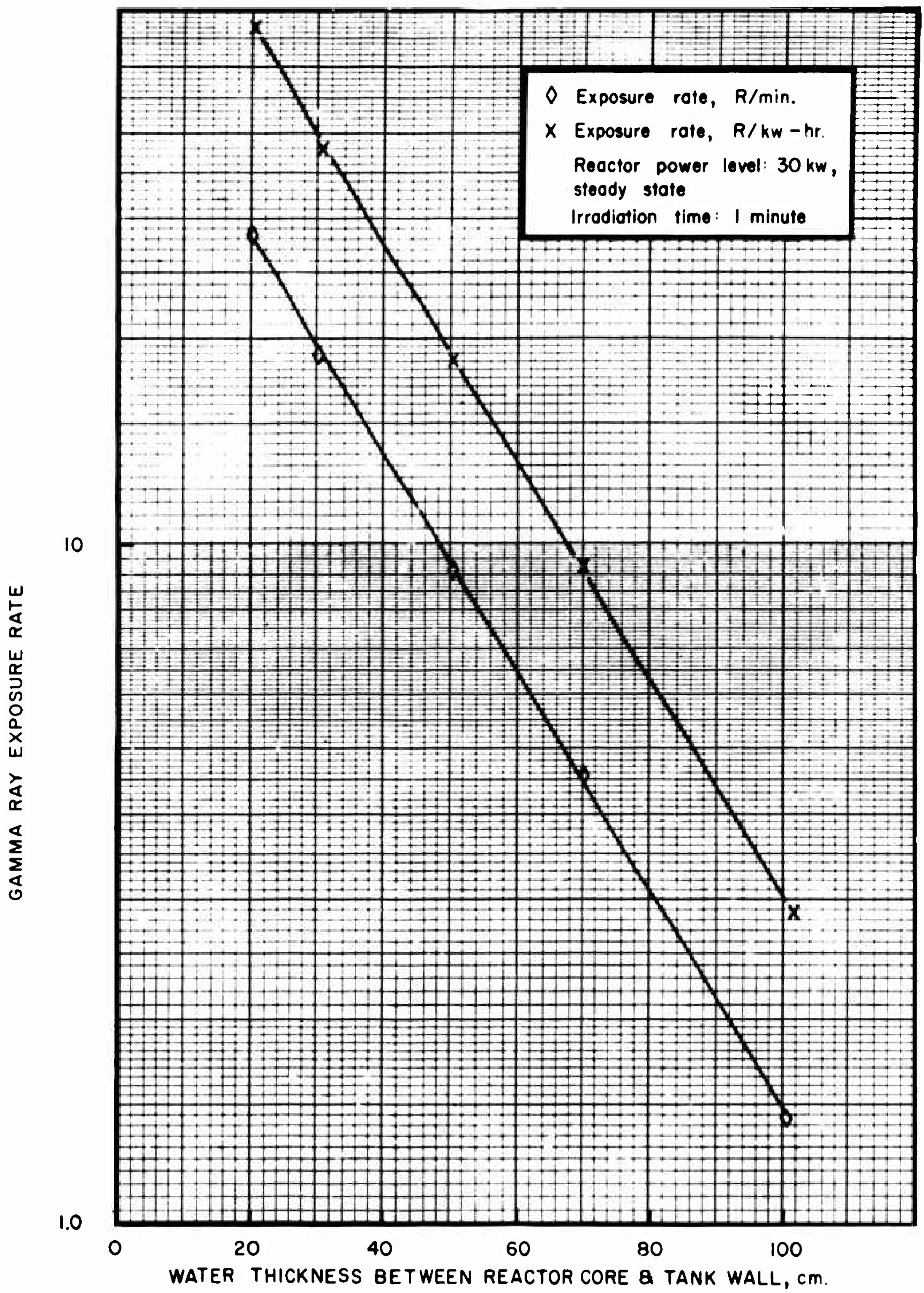


FIGURE 119. EXPOSURE ROOM GAMMA RAY EXPOSURE RATE, DETECTOR 300 cm FROM THIMBLE ON EXPOSURE ROOM MIDLINE AS A FUNCTION OF WATER LAYER THICKNESS BETWEEN REACTOR CORE AND TANK WALL.

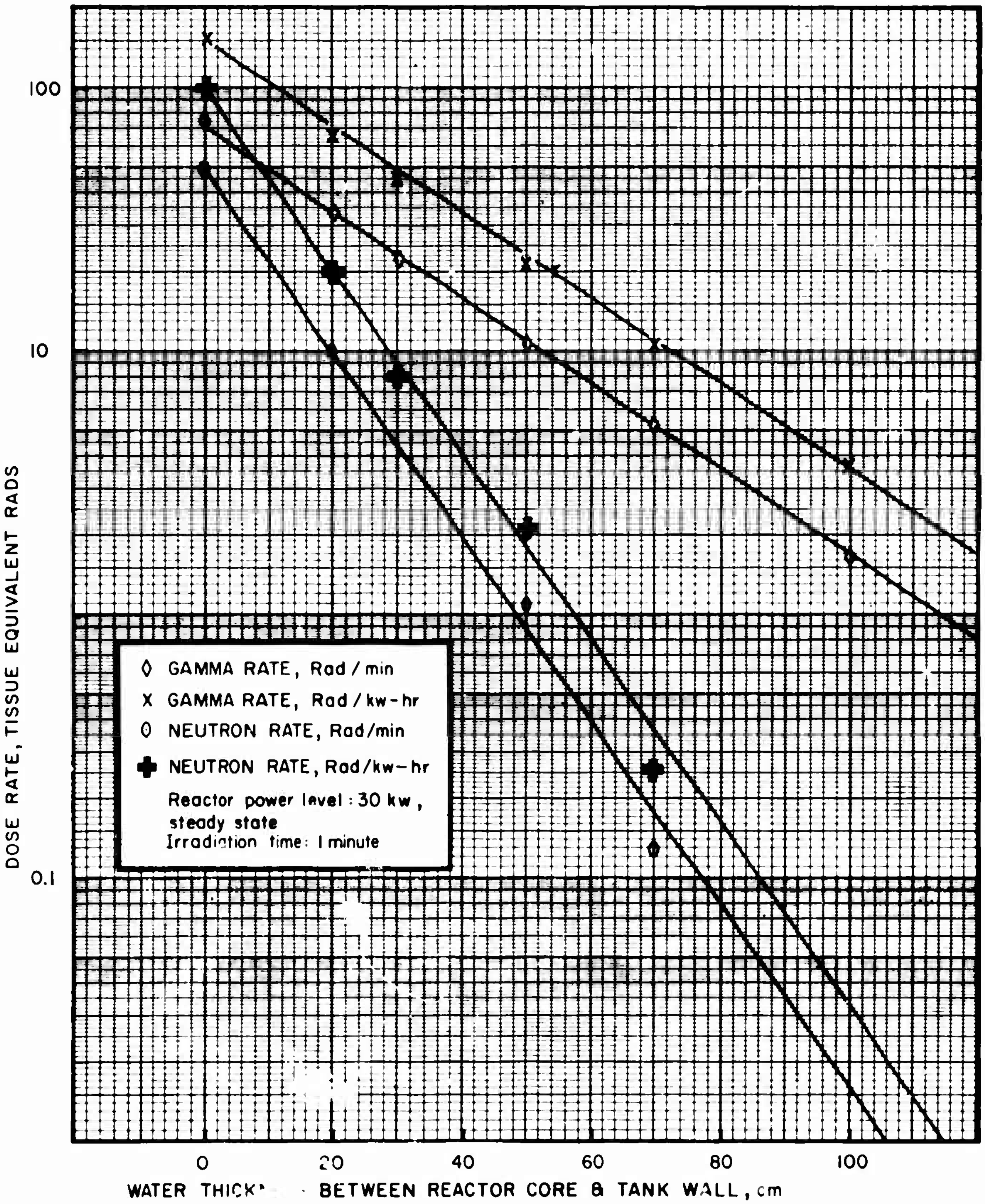


FIGURE 120. EXPOSURE ROOM GAMMA RAY AND TOTAL NEUTRON DOSE RATES, 300 cm FROM THIMBLE AS A FUNCTION OF WATER LAYER THICKNESS BETWEEN REACTOR CORE AND TANK WALL.

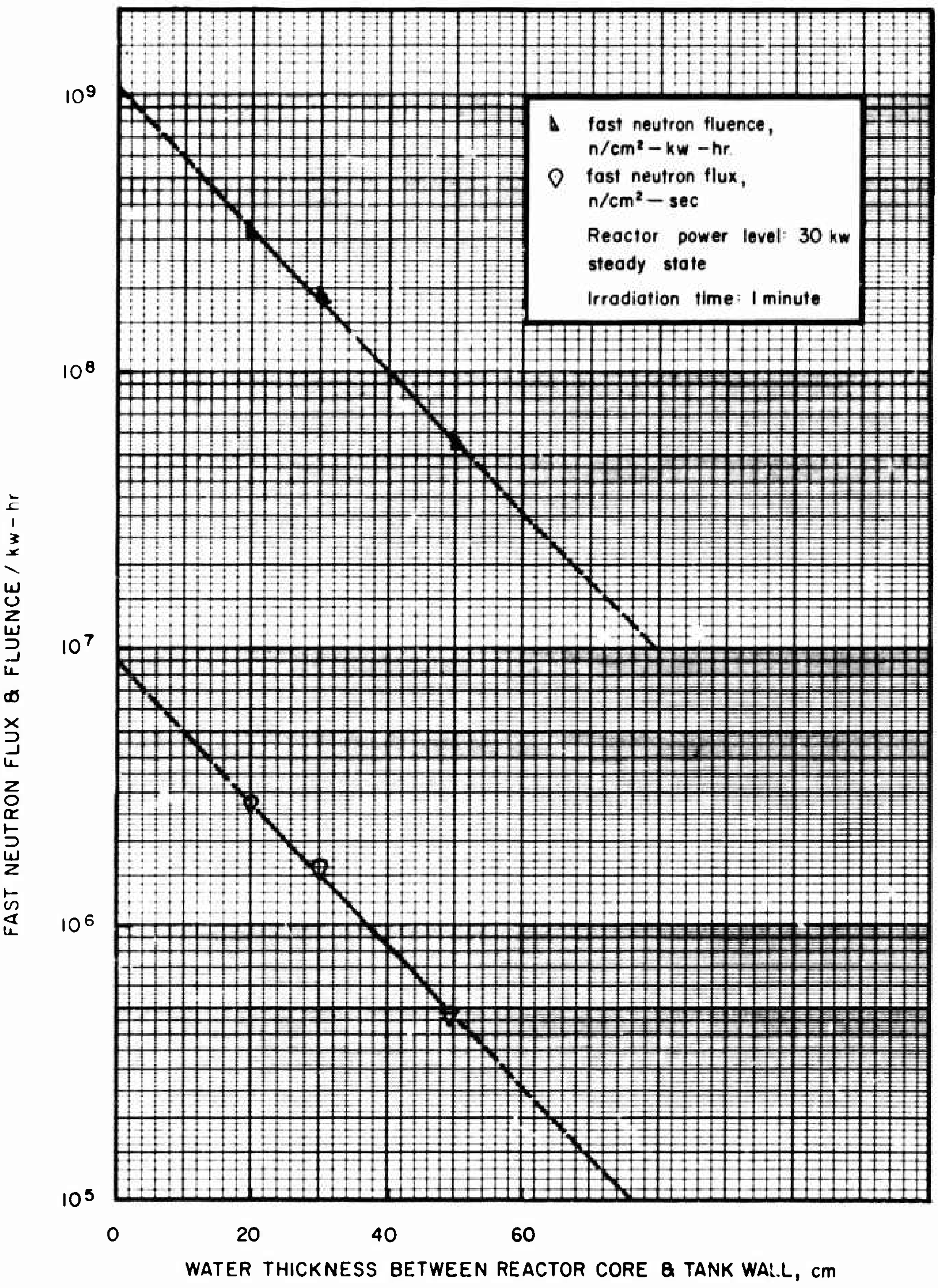


FIGURE 121. EXPOSURE ROOM FAST NEUTRON FLUX (E > 3.0 Mev), 300 cm FROM THIMBLE AS A FUNCTION OF WATER LAYER THICKNESS BETWEEN REACTOR CORE AND TANK WALL.

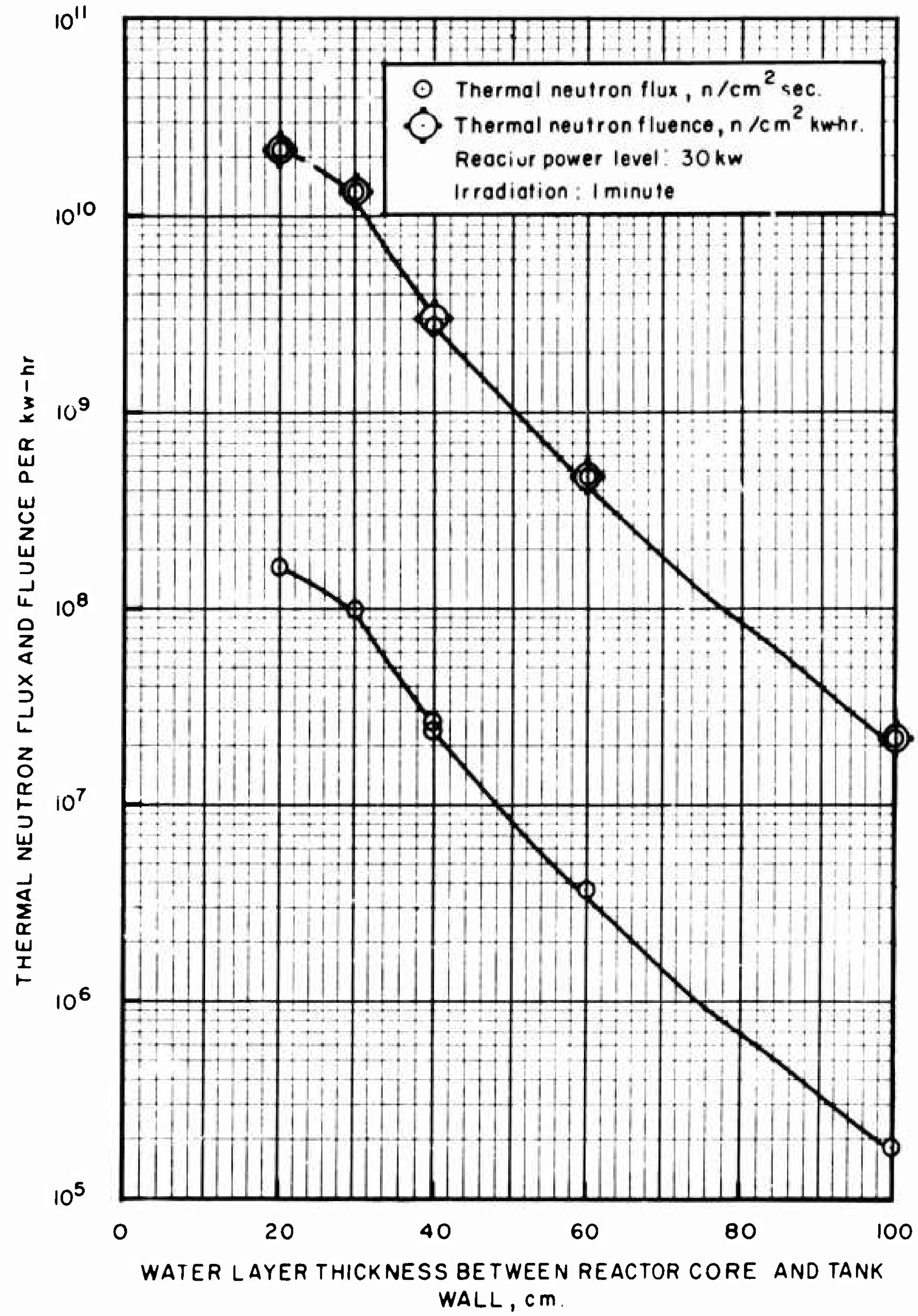


FIGURE 122. EXPOSURE ROOM THERMAL NEUTRON FLUX ($E < 0.4$ ev), 300 cm FROM THIMBLE ON ROOM MIDLINE (SEE FIGURE 10) AS A FUNCTION OF WATER LAYER THICKNESS BETWEEN CORE AND TANK WALL.

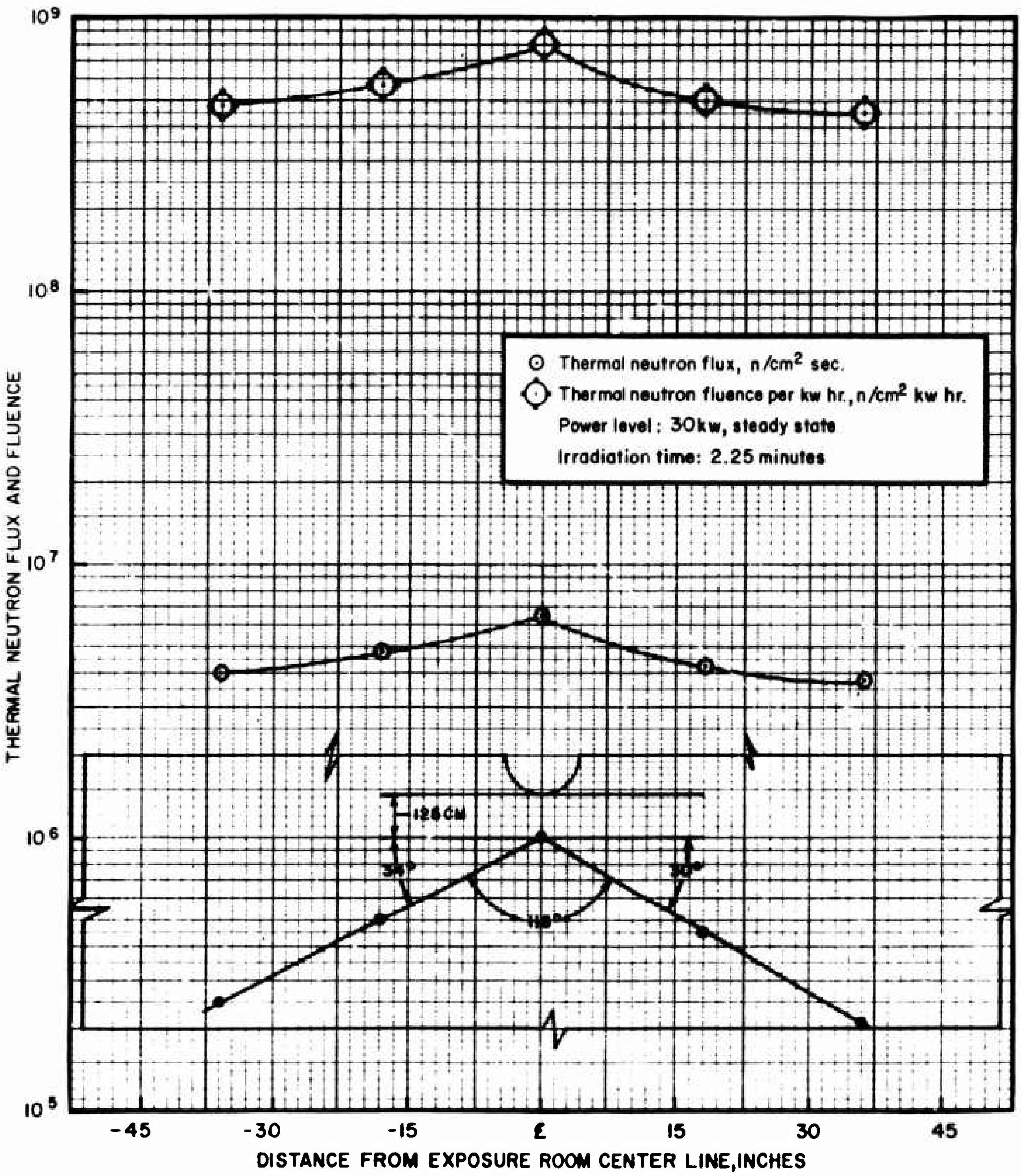


FIGURE 123. EXPOSURE ROOM THERMAL NEUTRON FLUX FROM THIMBLE ON ISODOSE LINE AS SHOWN

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2b. GROUP

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4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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13. ABSTRACT

Neutron fluence, fluence per kilowatt-hour, gamma ray exposure and gamma ray exposure rate were measured at the Harry Diamond Laboratories' Diamond Ordnance Radiation Facility. The data are presented in graphical form to facilitate its use.

The maximum attainable radiation exposure measured in the pulse mode is as follows:

Irradiation Area	Neutron Fluence (E > 10 kev) (n/cm²)	Gamma Ray Exposure (R)
Exposure room	6.8×10^{13}	5×10^{5}
Pool	5.2×10^{13}	3×10^{5}

The maximum attainable radiation exposure rate, measured at a reactor power level of 250 kw, is as follows:

Irradiation Area	Neutron Flux (E > 10 kev) (n/cm² sec)	Gamma Ray Exposure Rate (R/sec)
Exposure room	5.4×10^{12}	2.1×10^{3}
Pool	8.0×10^{11}	1.3×10^{3}

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14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
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